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ECONOMIC GEOGRAPHY

OCTOBER

AGRICULTURAL REGIONS OF ASIA
Robert Burnett Hall

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D. H. Davis

SPRING AND WINTER WHEAT ON THE COLUMBIA PLATEAU
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THE DEVELOPMENT AND DECLINE OF SKAGWAY, ALASKA
Edwin J. Foscue

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JAPAN

AN ISLAND empire fronting upon Earth's greatest ocean, Japan shares with Britain the insular maternity of the sea. Her mountain-ribbed acres domicile many millions of persons they can not support, who must turn to the seas that lap their shores for much of their sustenance. Few homes there are in Dai Nippon that do not overlook salt water; or send their men out upon the sea under the banner of the Rising Sun to trade with the nations of the world, far and near; or take from the fishing smacks that fetch to her ports their catch of fish upon which many of their simple meals are based.

Yet Japan's domain is not only the sea. Her well-tilled farms and gardens contribute to her imperial strength their share of provender, small though they be. Her paddy-fields, her tea-gardens, her rows of mulberries, her groves of camphor trees, her many little patches of oats, and bamboo, and yams—all these help to feed her busy, restless, industrious folk. Her tiny plains, her terraced slopes, her rugged shores, her ponds and lagoons—all these they turn to use for food and shelter and clothing.

All their thrift, all their cunning, all their industry can not avail to keep the wolf of national poverty from her door. As the numbers of her people increase, they must turn elsewhere than to further intensive use of their own islands for the additional food they need. Inevitably they must seek new fields, new gardens, new groves in foreign lands, from which to augment their native stores; failing to find new lands to till, they must starve. Naturally then they are bent upon territorial expansion, whatever the cost, whatever the sacrifice.

Millions upon millions of her folk await her imperial aggrandizement. New lands mean new families, new children, new aspirations, and new achievements. Confinement within her present insular limits means dearth, stagnation, distress, and even death. Who would cast her dice?

ECONOMIC GEOGRAPHY

VOL. 10 OCTOBER, 1934 No. 4

AGRICULTURAL REGIONS OF ASIA

PART VII

THE JAPANESE EMPIRE

Robert Burnett Hall

AGRICULTURE is the foundation of the Japanese Empire. It is the chief source of wealth and employment not only in the colonies but in Japan itself. The vigorous growth of Japanese industry and trade, the expansion of its merchant marine, the fame of the army and navy and the world-wide organization of Japanese diplomacy are all borne upon the shoulders of the peasant farmer. From the sludge of the rice fields has risen a mighty empire, and it is not the status of Manchuria, the Chinese boycott, or the oil concessions of Saghalin, that present the most serious political difficulties today, but rather it is the problems of maladjustment and unrest among the agrarian population and the working of the law of diminishing returns in agricultural production.

THE LANDS AND PEOPLE OF THE EMPIRE

The Japanese Empire is a part of Monsoon Asia and reproduces in miniature the picture of the whole. It is a land of mountains and small alluvial plains, of dense populations and ancient civilizations. In size, the Empire is 260,168 square miles, an area somewhat smaller than that of California and Arizona combined. Of this, not a fifth is arable, yet it supports a population which was 90,395,000 by the census of 1930. This gives a density over all of 347 to the square mile, and population increase is the most rapid of any major country for which there is reliable census.

	Area in Square Miles	*Population, 1930*	*Density per Square Mile*	*% Increase 1920–30*
Japan Proper ..	147,416	64,448,000	437.4	14.1
Chosen	85,229	21,058,000	247.1	22.0
Taiwan	13,887	4,594,000	330.8	25.7
Karafuto	13,929	295,000	21.2	178.6
Totals	260,168	90,395,000	347.4	17.4

Politically, the Empire is composed of (1) Japan Proper which includes the four main islands of Honshu, Hokkaido, Kyushu and Shikoku and some 470 small islands adjacent; the Ryuku (Loo Choo) Islands to the south; the Chishima (Kurile) Islands to the north; and the Ogasawara (Bonin) Islands which extend from south eastward into the Pacific, (2) Chosen (Korea), a peninsula of continental Asia, with its 1,018 small coastal islands; (3) Taiwan (Formosa) with the Hokoto (Pescadore) Islands nearby; and (4) Karafuto, the part of Saghalin Island lying south of 50° N.

The geomorphology of this area is

too complex to treat here in detail.[1] In general, the islands extending between Kamchatka and Taiwan are part of the great circum-Pacific fold and are but the summits of a mighty mountain chain which skirts the Pacific side of the continent of Asia. The islands are disposed in three arcs each separated from the continent by a sea. As the Chishima arc embraces the Sea of Okhotsk and the Ryukyu arc borders the East China Sea, so the central or Japanese arc embraces the Sea of Japan.

Erosion has been rapid. A copious precipitation, steep slopes and a drainage divide which is never far distant from the sea has led to many short streams which have carved deep valleys and have built delta plains at their mouths. Block-faulting has been active and alluvial plains occupy the floors of numerous interior fault depressions. These alluvial plains of the sea border and interior form the fertile rice lands of the archipelago. On the inner margins of these plains are diluvial terraces which are used extensively for dry crops. The continental area of Chosen is, in broad outline, a great tilted block. The eastern margin is high and bold while the western slope is long and gentle. A series of large delta plains skirt the western side, built by the numerous rivers which have carved the upland into a hill and mountain land. A few interior waste-filled basins and lower valley floors also offer fertile soils. The pat-

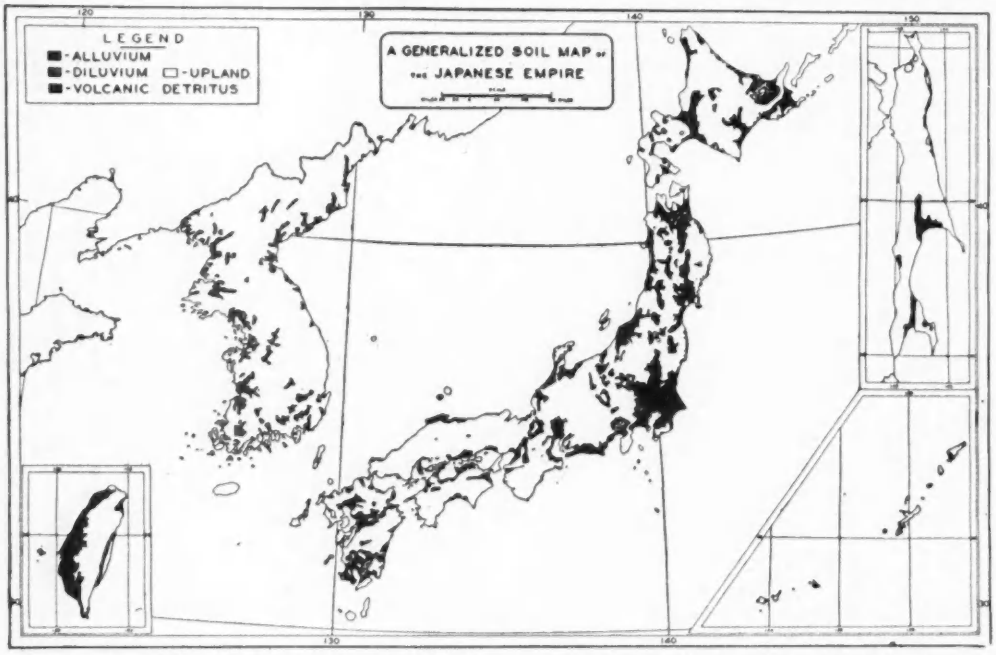


FIGURE 1.—The distribution of soils in the Japanese Empire emphasizes the restricted extent of alluvial lowlands, and the importance of vulcanism in the composition of soils as well as the geologic structure.

[1] Many excellent works appear in Japanese on the physical geography of the Empire and its parts. No adequate complete treatment is to be found in English or other Western language. On Japan Proper the recent "Physiographic Diagram of Japan," by Guy-Harold Smith, with "Notes" by Glenn T. Trewartha, *Geog. Rev.*, Vol. xxiv, No. 3, July, 1934, p. 400–403, is to be recommended. Hall, R. B. and Watanabe, A., "Landforms of Japan," Papers Mich. Acad. Soc., Vol. 18, 1932 (Pub. 1933), p. 157–207, has been freely used in the regional descriptions to follow.

tern of surface and soils in Chosen, genetically of different origin, is quite similar to the island parts of the Empire as far as the requisites for agriculture are concerned. In determining the main agricultural divisions or regions of the Empire, surface differentiation is of secondary consideration.

The long extent of the Japanese arc, through 29° of latitude or 2,100 miles, the different exposures offered to the summer and winter monsoons, typhoons and the proximity of the Japanese and Bering Currents create a diverse climatic pattern. The continentality of Chosen and to a lesser extent, Karafuto, add to the complexity. Even by world classifications, several major divisions are recognized. By the Koppen Classification A (tropical), C (mild winter), D (severe winter), and E (polar) climates are found. A, C and D are each represented by the f or humid and w, winter drought, climates. The marine, b, and continental, a, phases also occur. E. Fukui has recently brought together and issued under one cover the "Climatic Provinces of Japan," which is the result of his tireless effort and numerous publications over a period of several years. This classification is largely descriptive but is very well adapted for a regional study of the Empire.[2]

THE MAJOR CLIMATIC DIVISIONS AND PROVINCES OF THE JAPANESE EMPIRE AFTER E. FUKUI, "CLIMATIC PROVINCES OF JAPAN"[3]

I. *Northern Japan* is the coldest area in the Japanese Empire and for at least four months the mean temperature is below 0° C.

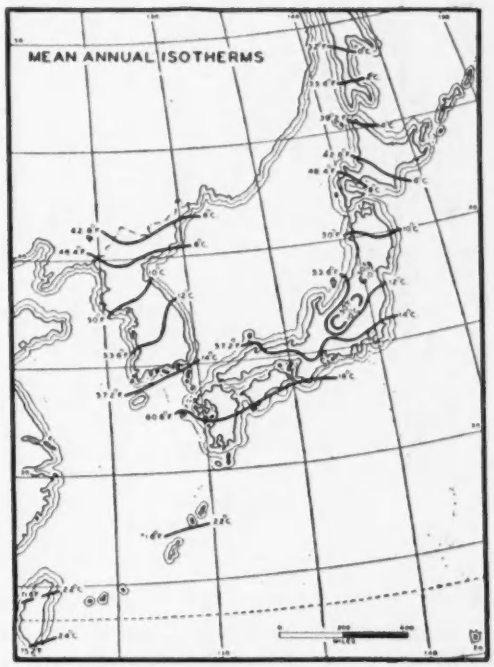


FIGURE 2.—The marine control of the climate of the main islands of the Japanese Empire insures favorable temperatures for comfortable living and excellent agriculture. More continental conditions affect Chosen. Hokkaido and, in a greater measure, Karafuto suffer lower temperatures because of their higher latitude and the absence of warm ocean currents in proximity to their shores.

A) *The Karafuto Province* is the coldest of all. Here at least five months have mean temperatures below 0° C. It is, with northern Chosen, the driest part of the Empire. Evaporation is low.

B) *The Hokkaido Province* has a mean temperature of less than 0° C. for four months of the year.

II. *Central Japan* has the moderate climate in the Empire. The mean annual temperature is below 20° C., but mean temperatures below 0° C. prevail for less than four months.

C) *The Southwest Hokkaido Province* is warmer than the Hokkaido Province. There are less than four months with a mean temperature below 0° C.

D) *The North Korean Province* is characterized by cold winters, as are the Karafuto and Hokkaido Provinces, but summer temperatures are considerably higher. The annual range of temperature is great and winter precipation is small.

[2] Thornwaite, C. W., *Geog. Rev.*, Vol. xxiv, No. 3, July, 1934, p. 495, published a map of his quantitative classification for Japan. His pattern of climates is closely similar to that of Fukui's. I have used freely from Professor Fukui's work along with that of the excellent compilation by Okada, T., "The Climate of Japan" (*Bull. Cent. Meteoral Obs. of Japan*, Vol. 4, 1931).

[3] *Geog. Rev. of Japan*, Vol. 9, Nos. 1–4, 1933. Reprints bound in monograph form and include a brief abstract in English.

E) *The Pacific Province* is characterized by an abundant summer precipitation, both at the time of the bai-u and during the period of the typhoon. Winter weather is mild and sunshiny. Snow is less frequent and much lighter than on the Sea of Japan side, but hoar frost is more frequent. Along the eastern and southern slopes of the Central mountain land, föhn winds are experienced in winter.

F) *The Japan Sea Province* has an abundant winter precipitation which well exceeds that of summer. This is the snowiest part of the Empire and cloudy and dismal weather prevails during the winter months. A considerable summer precipitation is also received, especially at the times of the bai-u and typhoons. Frost is not frequent and the föhn is often experienced in the piedmont region during summer. (See map of summer and winter precipitation.)

G) *The South Korean Province* is relatively quite dry especially on the Japan Sea side. Snows are very rare but winters are relatively cold.

III. *Southern Japan* has a mean annual temperature of more than 20° C.

H) *The Ryukyu Province* has high temperatures throughout the year. July is the warmest month. A copious precipitation (2,000–3,000 mm. annually) is received and is influenced both by the summer and winter monsoons. In northeastern Taiwan there is a winter maximum of precipitation. Typhoons occur in late summer and bring heavy downpours. Snow and hoar frost are virtually unknown on the lowlands.

I) *The Taiwan Province* is the warmest district in Japan and receives an abundant rainfall. The summer monsoon is masked by the trade winds and so is not pronounced. The typhoons bring the heaviest precipitation. The northern mountain lands are very dry in winter in spite of high temperatures.

J) *The Ogasawara Islands Province* has a quite uniformly warm climate and a comparatively small precipitation. Both the summer and winter monsoons prevail. The typhoon season has an abundant rainfall.

Climate is critical in a study of agricultural regions in as far as it effects (1) the distribution or limits of specific crops or association of crops and (2) the acreage, yields and methods of production of those crops. In the Japanese Empire, rice persists as the most important crop from the southern extremity almost to the northern periphery. Only northern Hokkaido, Karafuto, and north central Chosen are excluded, though experimental rice cultivation is now being carried on in southern Karafuto. Associated throughout with the characteristic and generally uniform paddy landscape are dry grains of different kinds. The distribution of the different dry grains varies so as to form an important guide for determining the secondary divisions or districts. A more significant condition for the primary or

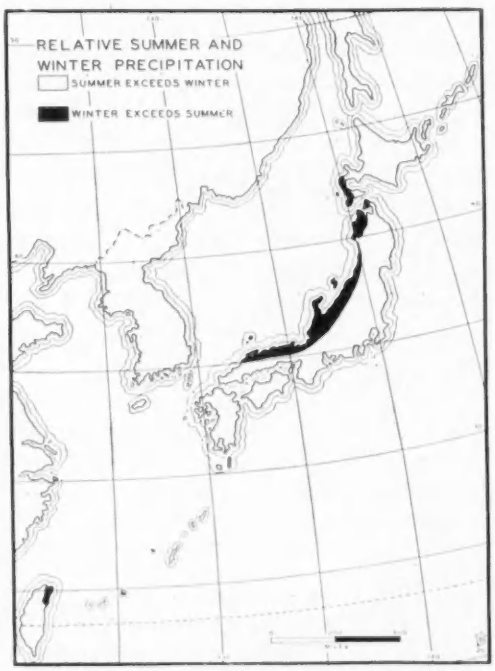


FIGURE 3.—The western coast of the islands, Hondo and Hokkaido, and the northeastern Taiwan are exceptions to the general rule of summer maximum in the Monsoon régime. Both exceptions are caused by outblowing winds crossing bodies of water and then being forced to rise over mountains.

regional differentiation is that of single and double cropping. The intensity of agriculture in the Japanese Empire is expressed not only in the generous application of labor, fertilizer and capital on small areas, but also in using the land, wherever possible, more than once during the year. The possibility and degree of utilization in this way differs more greatly with climate than with any other factor. On the basis of the biannual utilization the Empire may be divided into three regions:

(1) The region in which two crops of rice are possible, includes the lowlands of Taiwan, the Kochi Plain of southern Shikoku and a few very small areas are reported from the southern shore of the Kii Peninsula. In Taiwan, the first crop is planted in February or March and harvested in June or July. The second crop is planted in July and August and harvested in October or November. The first crop is of good quality in the north and the second in the south. On the Kochi Plain, the two-crop system is largely the result of a model irrigation system. The first crop grows from April to July and the second from July to November.

(2) The region in which two crops of rice cannot be grown, but in which dry crops are planted after the rice is harvested. This region includes Shikoku, other than the Kochi Plain; Ryukyu; Honshu, except for the greater parts of the Hokuroku and Ou Districts; and Southern Chosen. Rape is an important second crop in Hyushu, Kinki and Kwanto. Rye or naked barley is the preferred crop on better quality paddies and "mugi," wheat or barley, are widely used. The degree to which double cropping is practiced within these limits is largely a matter of the maturity of settlement, as well as temperature and drainage conditions. Double cropping is practiced on about 23% of the

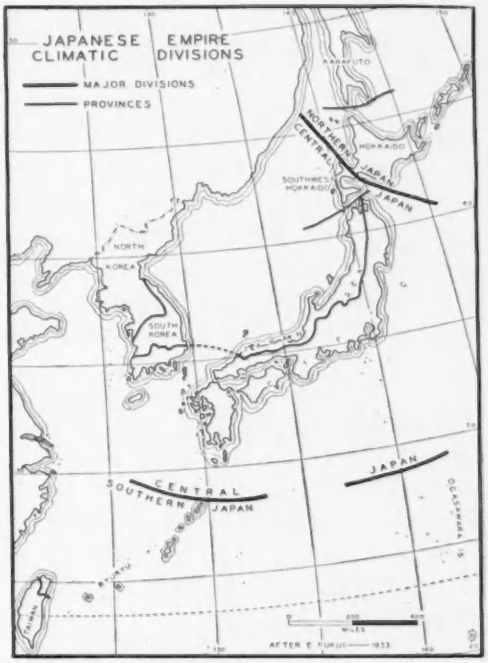


FIGURE 4.—Temperature, as latitudinal response, account for the major climatic divisions; amount and distribution of precipitation form the basis for most of the minor divisions, or provinces.

paddy fields of the Kwanto District; 28% in Southern Chosen; 30% in Ryukyu; 47% in Tokai; 58% in Kinai and as much as 81.7% and 92.8% in Fukuoka (Kyushu) and Kagawa (Shikoku) Prefectures, respectively.[4] Relative population densities on the agricultural lands of the Empire are strongly influenced by possibilities and degree of double cropping. The value of land is also closely related. In Kochi Prefecture, where two crops of rice can be secured, superior paddy was valued at 1,043 yen (the par value of a year is $0.498) per tan (1,186.1157 square yards) in 1928. This was the highest average value of any prefecture in Japan, except for Tokyo Prefecture where Tokyo City alters all values. In Nara Prefecture, where 65% of the paddy is planted in fall dry crops the value of superior paddy was 760 yen and in

[4] Nasu, H., "Modern Industry Series," Vol. I, p. 101–104 (in Japanese).

Aamori Prefecture where practically no double cropping is practiced the value was 468 yen.

There is a great deal of multiple crop production on dry land farms, which has not been considered in this classification. Inter-tillage and seasonal crop rotation are both used to secure more than one crop from dry land farms.

The rearing of livestock other than those used as work animals is not an important industry in the Japanese Empire. The lack of pastures, Buddhist prohibitions, and the pressure of population on the land have been important obstacles to its development. Fowl, throughout the Empire, and pigs among the Chinese of Taiwan are exceptions. Both are scavengers and do not compete with man for food.

The types of work animals employed for farm work differ considerably from area to area, as will be seen on the accompanying map. This pattern of distribution is a matter of both the cultural heritage of the people and the combined factors of temperature and paddy cultivation. Horses do not thrive under hot, wet conditions. Their predominance in southern Kyusha and Ryukyu is not great and is explained in part by the relatively large proportion of dry field cultivation. This distribution is of value in determining the major divisions of the Empire.

Throughout the Japanese Empire, the same general surface pattern is found. Every part is distinctly mountainous and the small sea border and interior plains furnish the great bulk of the agricultural land. These plains are separated from one another by high mountains. In spite of the variety of climatic conditions, a grain agriculture in which rice predominates, persists almost throughout the entire extent of the Empire. In this ancient land, the cultural landscape is most highly developed. Each plains area constitutes a culture center and has extended its influence up-valley from it to the very head. The slopes are generally unoccupied and undifferentiated from one another agriculturally. Where they are cultivated it is invariably a continuation of the cultivation of the adjacent plain. The self-sufficiency of each locality, built up through the centuries, still persists. It is obviously impossible to delineate broad, homogeneous cultural regions of any kind as can be done in the Americas or in Australia, where the natural patterns are on a larger scale and where the cultural impress is not so firmly established.

The methods used in delineating the following regions and districts is analytical. First, the plains were studied individually and then grouped according to similarity. Drainage divides are used as boundaries because of the cultural homogeneity enclosed by them. These divides not infrequently coincide with climatic and other natural limits.

The major divisions or regions coincide with the four major cultural divisions of the Empire. Three are areas of individual and ancient civilizations which had reached a climax stage long before their contact with the Occident—the Old Japan Region, the Ryukyu-Taiwan Region and the Chosen Region. They represent the old Japanese, south Chinese and Korean cultures respectively. The remaining region, that of northern Japan has been settled agriculturally only since the Restoration and has been influenced strongly by the Occident. The four regions have been further divided into 21 districts. (See Figure 6.)

THE "OLD JAPAN" REGION

The "Old Japan" Region has been amply described as a whole, and little general description will be attempted

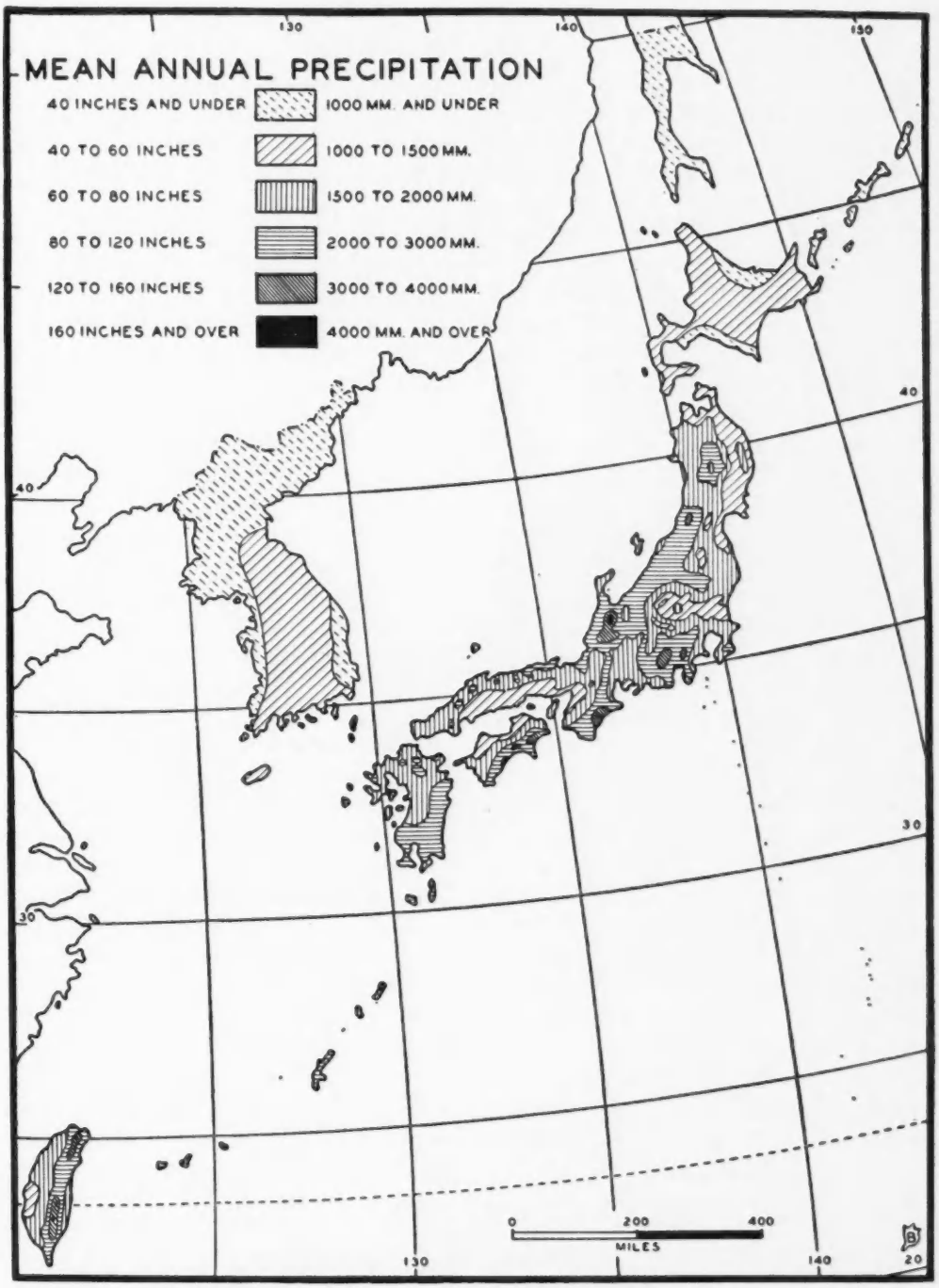


FIGURE 5.—Marine conditions, and mountains across the path of the Monsoon winds, provide the Japanese islands with an abundance of precipitation; nowhere except in the northern areas and in continental Chosen does the annual precipitation fall below forty inches.

here. Briefly, this region is the most densely populated, intensively cultivated, and productive part of the Japanese Empire. In contrast with the other region, there is a relatively more homogeneous agricultural landscape throughout and a relatively more uniform distribution and predominance of paddy land. Localized specialization is more highly developed, because of better markets and transportation. In spite of practicing the most intensive form of agriculture and securing by far the highest yields, it is the least self sufficient, and to it flow the food and raw material surpluses of the other regions of the Empire.

A number of excellent books have appeared in recent years. Among them are: Robinson Scott, J. W., "The Foundations of Japan"; Orchard, J. E., "Japan's Economic Position"; Moulton, H. G., "Japan: An Economic and Financial Survey"; Crocker, W. R., "The Japanese Population Problem"; Nasu, S., "Land Utilization in Japan," and an article on agriculture in "Modern Industrial Series."

THE OU DISTRICT

No exact English translation of Ou is possible, "O" means a recess and "u" a wing. The Ou District encompasses the northernmost end of the Island of Honshu. It is the largest district of Japan proper, but has the sparsest population and is the least developed. Several factors contribute to this latter condition. Winters are longer and colder than to the south and, in general, only summer crops can be grown. Japanese settlement moved northward in Honshu from the Kinki area and so came relatively late. Reclamation during the later feudal days and since the Restoration has brought most of the irrigable plains areas into paddy but much development in detail is yet to be done. There is also a relatively small percentage of level land in the Ou district. Finally, there is not the intensive use of land so common to the south because of the lack of important urban markets. Ou is dominantly agricultural. Excepting for the production of a little petroleum in the Dewa Hills behind Akita, the Kosaka copper mine in the northern part of the Central Mountains, the iron of the Kitakami Mountains, and the Zyoban coal field of the eastern Abakuma Mountains there is little primary production that is not agricultural. Industrialization has made little headway and urbanization consequently has not kept up with the average for Japan. In fact, Sendai is the only city of 100,000.

Climatically, Ou is transitional between the mild winter lands of Old Japan and the severe winter lands of Hokkaido. Its southern limit corresponds roughly with the mean January isotherm of 0° C., at sea level. Winters are too long and severe to allow a double cropping of the land. The growing season is a month shorter than in southwestern Japan. Extending entirely across Honshu, it falls within both of the major climatic provinces of Japan Proper, i.e., the Sea of Japan and the Pacific. The former is characterized by a winter maximum of precipitation, largely in the form of snow brought by the northwest monsoon. Less snow falls than along the coasts immediately southward but heavy snow accumulations do occur and persist for long periods of time. Winters are considerably colder than those to the south or in eastern Ou. The bai-u and the typhoons bring rather copious rainfall in their seasons. Three mean monthly maxima are recorded. In order of importance these are December, September, and June. In the Central Mountains the order is September, June, and December. Eastern Ou has but one maximum of precipitation

and this occurs with the typhoon season in September. The bai-u and midsummer monsoon rains are heavy. Summer temperatures are considerably lower than on the Sea of Japan side. Winter is characterized by fine, clear weather and there is little snow. However, the Central Mountains are not high enough to cut off entirely the influence of the winter monsoon and occasional snow accumulations do occur even on the Abakuma Lowland. In fact, the contrast between east and west in winter weather is less sharp in Ou than elsewhere in Honshu.

The general pattern of surface features comprises three subparallel mountain systems with intervening structural depressions. Each of the mountain systems is thought to be an elongated upwarped dome, the margins of which in many places have been dropped down by faulting. The eastern mountain system, geologically, belongs to the Outer Zone of northeast Japan and is made up of older rocks, with numerous intrusions. It is not a continuous range but rather is divided into two distinct parts at the Bay of Ishinokami. North of Sendai are the Kitakami Mountains, which descend to the west by what appears to be a highly dissected flexure scarp. Toward the Pacific, the descent is gradual and is interrupted along the northern half by a fringe of marine terraces reaching maximum elevations of 300 meters. A drowned and ragged coast line characterizes the southern half. The Abakuma Mountain land has a belted coastal plain along the Pacific margin and drops westward to the Abakuma Lowland by an abrupt fault scarp. Both the Kitakami and Abakuma Mountains are characterized by extensive peneplain remnants, lying at about 1,000 meters elevation. Numerous monadnocks rise to several hundred meters above this old surface.

The second and middle mountain system of Ou is generally termed the Central Range and is the backbone of Northeast Japan. It extends, virtually unbroken, for the full length of the district. Unlike the eastern mountain system, the Central Range is made up chiefly of Tertiary sediments. Seven volcanic clusters, lying nearly equidistant from one another, cap the Tertiary surface and tower above it. Each cluster contains one or more great conical volcanoes accompanied by numerous minor attendants.

FIGURE 6.—The delimitation of agricultural regions agrees well with the climatic division, and reveals the great influence of climate on Japanese land utilization. Relief is responsible for more local and secondary distinction.

The western mountain system varies greatly in elevation. In some places it is little more than low hill country with an average elevation of 400 or so meters, while in others it presents a maturely dissected surface of high relief with maximum elevations well in excess of 1,000 meters. The Dewa Hills com-

prise the northern portion while the Asahi-Iide Mountains make up the southern.

The Kitakami-Abakuma Lowland which separates the eastern from the central mountain systems presents a variety of surface conditions. The borders appear in places to be flexure scarps and in other places are faulted. Throughout the entire length an erosion surface at an elevation of from 100 to 300 meters can be recognized. In the northern half, wide remnants of this initial surface remain while in the south erosion has caused extensive areas of hilly land. The western margin is buried beneath great and composite alluvial fans built by the torrential streams descending from the Central Mountains.

The Central Mountains are separated from the Dewa Hills and the Asahi-Iide Mountains by a chain of seven waste-filled fault basins. The streams draining these basins cut through the western uplands and empty into the Sea of Japan.

A string of fault depressions skirts the Sea of Japan Coast. Delta deposits have built wide alluvial plains in them, but in places they are buried beneath gigantic and youthful volcanoes.

The longitudinal arrangement of lowlands affords natural and easy lines of communication for north-south trunk line railways and highways. Numerous low passes in the Central Mountains allow ready access between the plains on either side while the wide valleys through the western uplands make transport easy to the Sea of Japan. The belted coastal plain on the Pacific side south of Sendai is most favorable, but the rugged submerged coast to the north makes land transport very difficult. These numerous and somewhat isolated lowlands support most of the population and afford the bulk of the arable land of Ou. Each plain and basin in addition to the rural population supports one or more centers of population and commerce. The more important towns are relatively ancient and were castle towns in feudal days.

The economy of the Ou district is almost exclusively agriculture. As an agricultural entity, it differs from the rest of Central Japan in several important respects. It lies beyond the northern limit of double cropping, as the growing season is too short and the winter too long and severe to allow a dry grain harvest before the rice planting. Only on the Abakuma Lowland is an exception to this found, and even here it is not the common practice. It is also beyond the northern limit of tea. The sweet potato, so widespread to the south, has virtually disappeared. Mulberry and an accompanying sericulture are of far less significance than elsewhere and are found chiefly in the southern portions and especially in the vicinity of Sendai. Ou is definitely the northern transitional area in this production. Climatically, the area is well suited to deciduous fruit production and in recent years the cultivation of apples and fruit cherries has been undertaken and Ou now accounts for the bulk of all such production in Japan. Rice is the first crop of the district and occupies all of the irrigated alluvial lands. It accounts for over half of the arable area, i.e. 490,000 cho (a cho is 2.4507 acres) out of 881,000 cho. The plains bordering the Sea of Japan and those about Sendai have long exported their surplus of rice to the older and more densely populated parts of Japan. Furthermore, Ou is still in an immature stage of occupancy and there is an opportunity for expanding both acreage and yields.

Good pasture grasses occur on the terrace tops and volcanic flanks of the eastern moiety. The production of barn yard millet in Ou far exceeds that of any

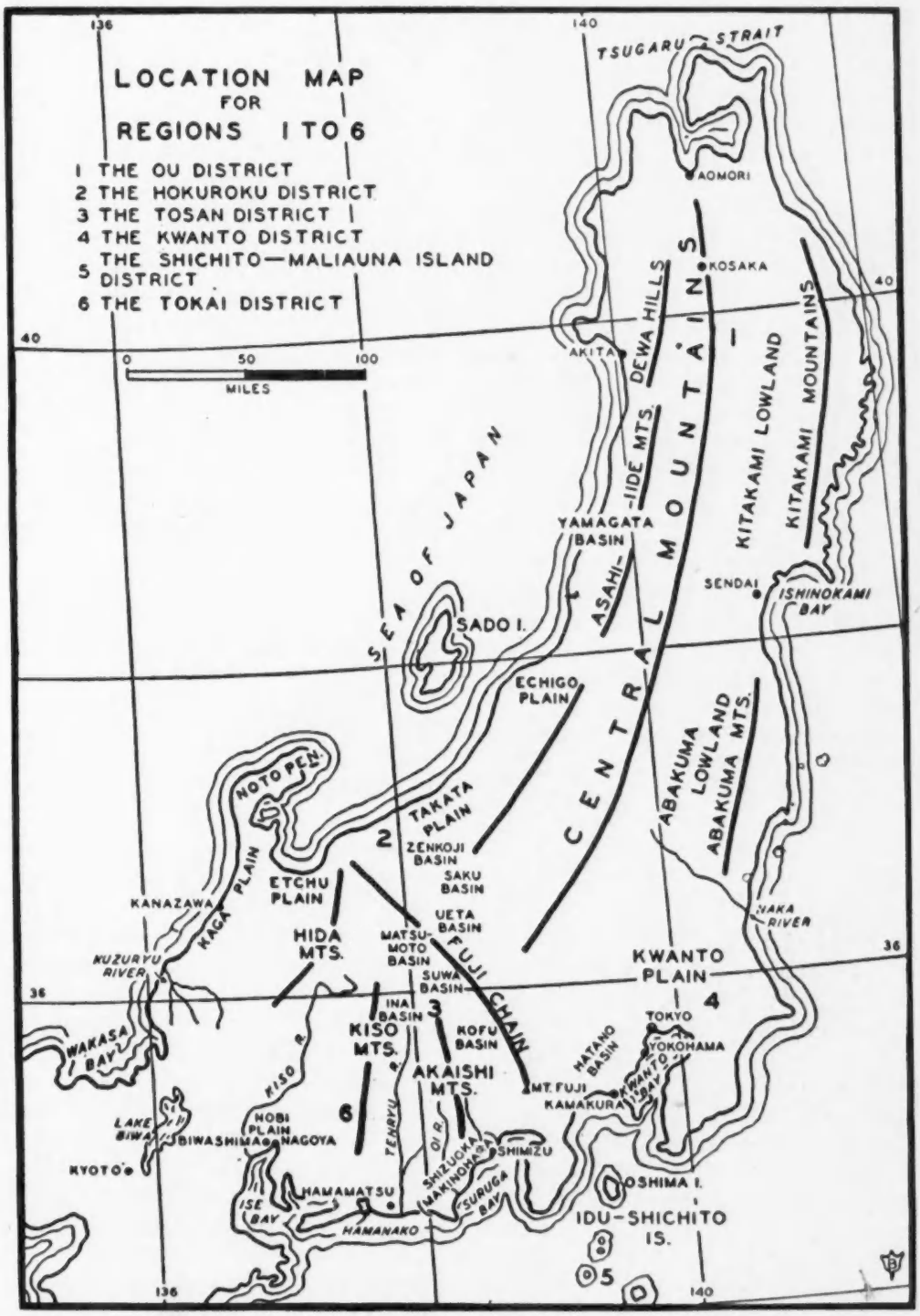


FIGURE 7.—The chief localities discussed in the text are indicated upon this map of locations.

other district and supplements the pastures as forage. With low temperatures and a relatively low precipitation a thriving horse-rearing industry is found. In beans and white potatoes Ou also exceeds and this production is confined largely to the eastern half. The extensive areas of hilly land in the eastern part account to some extent for the larger size of farms and for the relatively large area of dry grain fields, especially millet, buckwheat and barley. A northward extension and the northern limit of tobacco cultivation is found on the southerly Abakuma Lowland.

In the western part of Ou paddy rice is all predominant and far exceeds the eastern half, because of the larger areas of alluvial plain. The western plains produce a large surplus of rice, which is of excellent quality as the harvest season is sunny and dry. About 70% of all of the apples raised in Japan are found in Aomori Prefecture and are concentrated on the terraces, lower mountain slopes, and near the rivers of the Tsugaru Plain. The apple industry and the fruit cherries of the Yamagata Basin are innovations of recent years.

THE HOKUROKU OR NORTH COUNTRY DISTRICT

The Hokuroku District is made up of a series of sea border plains and their backing mountain slopes extending along the Japan Sea in the middle portion of Honshu. The Echigo, Takata, and Etchu plains each occupy a fault depression which has been filled by the delta deposits of the one or more large rivers flowing into them. Wakasa Bay, which forms the southern border of the district, is of similar origin, but only small isolated deltas have as yet formed in the numerous bay heads of its indented coast. The Kaga Plain includes the Oochigata graben which cuts across the center of the low-warped dome that forms the Noto Peninsula and the wide alluvial valley of the lower Kuzuryu River. Sado Island, with its central alluvial plain, also falls within this district.

The Hokuroku District conforms almost exactly to Fukui's climatic region of Hokuroku and lies within the Japan Sea Province. The mighty mountains which back the coastal lands abruptly check the moisture-laden winter monsoons, and snow accumulations of as much as four meters are experienced frequently. The heaviest snows in Japan occur in the central portion, including the Takata, Etchu and northern Kaga Plains, while in the north the Echigo Plain and to the south the southern part of the Kaga Plain experience somewhat lighter accumulations. Winter weather, throughout, is cloudy and depressing and winter precipitation markedly exceeds that of summer. The bai-u and typhoons, however, bring heavy rains and three maxima occur, in the following order of importance: December, September, and June. Violent floods often come with the spring thaw and lesser floods occur in the typhoon season. The foehn is of rather frequent occurrence in summer.

Three major problems affect the economic development of Hokuroku. The great mountain backbone of Honshu isolates this district from the main markets and ocean gateways of Japan. A superabundance of water, although in some respects favoring paddy culture, creates a serious flood hazard and makes necessary costly reclamation. Finally, during feudal times a class of wealthy landlords rose above the local feudal government and virtually enslaved most of the agricultural population. The problem of tenancy here and on the western plains of Ou to the north is an exceedingly difficult one today. The combination of severe winters and the

landless condition of the peasantry has led to large scale migration to Hokkaido and Brazil.

The plains of Hokuroku are the most highly specialized paddy areas in Japan and produce about 15% of the national rice crop. Rice is both the sustenance and money crop. Large surpluses go annually to the industrial centers of eastern Honshu. The flat mud coasts afford poor harborage, yet every plain has its port for rice export which has functioned since early feudal days. Old beach ridges and levee remnants offer dry point sites for settlement and afford land for vegetable, mulberry, and other dry crop cultivation. On the Echigo and Kaga Plains newly planted orchards of pear and peach are found. A little tea is also grown and the Echigo Plain is the northern limit of tea cultivation on the Japan Sea side. Mulberry is more important on the Kaga Plain than elsewhere in Hokuroku and there is a thriving and ancient silk spinning industry centering on Kanazawa, the largest city on the Sea of Japan. A small surplus of soy beans is exported from Echigo.

Even if it were not for the severe winters, double cropping would not be possible on most of the plains areas on account of inadequate drainage. In the more marshy areas lotus are raised for their roots and seeds. On the Echigo Plain, a tulip industry is getting under way. On Echigo, too, the problem of drainage is most critical and large and costly drainage canals are being constructed. Conversely, inundation is the natural condition and the problems of irrigation are most simple.

FIGURE 8.—On the heavily flooded parts of the Echigo Plain water oaks are planted along the dikes to be used as drying racks for the rice harvest.

The fishing industries are important and many farmers are employed part time by them. On the Etchu Plain, an ancient industry persists among the farmers in the manufacture of medicines. There is little other production from the region, excepting oil fields in the Tertiary hills near Niigata.

A little should be said about the adaptation of man to the rather harsh conditions of Hokuroku. The rural house is of heavy board construction and the

thick wooden shingles are held down by stones. High and dense hedges surround and protect the farm dwellings, particularly on the Etchu Plain. The flood hazard has forced the picking of dry point sites. On the Echigo Plain it has led to serpentine villages along the old beach ridges and levees while on the steeply inclined Takata and Etchu Plains it has led to a disseminated pattern of rural settlement, each house occupying its own elevated lot. Water oaks are planted along the dikes and roads and support drying racks for the rice harvest (Figure 8). In the wetter fields only the tallest varieties of rice can be grown and small elevated platforms are built in each paddy to stack the rice which must be harvested by boat. Railroad traffic is often interrupted by snow and flood. To offset this the tracks are laid on high embankments and on the Takata Plain run beneath wooden tunnels.

THE TOSAN OR EAST OF THE MOUNTAIN DISTRICT

The agricultural lands of the Tosan District are largely confined to the floors and slopes of the numerous local structural basins which lie at the bases of the mountain lands which form the eastern and western boundaries of that great zone of subsidence, the Transversal Lowland or Fossa Magna. Beneath the towering western scarp, which has a general height of 2,000 meters and extends across middle Honshu from the Pacific to the Sea of Japan, are the Kofu, Suwa, and Matsumoto Basins. The Ina Basin extends southwestward from the Suwa graben along the Tenryu River. These basins are separated from the Saku, Ueta, and Zenkoji Basins by the many gigantic volcanoes of recent origin which have buried the central part of the Transversal Lowland and which constitute what is sometimes called the Fuji chain. The torrential streams which tumble from the adjacent mountain lands have buried the floors of the Tosan Basin with steeply inclined alluvial fans. The lowest of these basin plains, the Zenkoji, lies about 300 meters elevation. The Matsumoto graben lies at 450 meters and the Suwa, which is the most elevated, lies at over 750 meters.

The climate of Tosan falls within the Pacific Province, which indicates an excess of summer precipitation over that of winter. Much less snow is received than on the Sea of Japan side but deep snow accumulations do occur at higher elevations. Frosts are frequent and constitute something of a hazard to agriculture and in late summer and fall heavy land fogs form in the basins and valleys. Winters are exceedingly cold and summer temperatures are very high. The bai-u and the typhoon seasons bring heavy rains.

The Tosan District is the first silk producing area of Japan. Coarse textured soils, a dearth of level land, the difficulties of irrigation and the somewhat unfavorable climatic conditions discourage general agriculture and particularly the production of rice. Mulberry, however, succeeds quite well, and although natural conditions are not as favorable to it as in many other parts of Japan, cheap land and cheap labor have made it the all important industry. In fact, mulberry has not only spread over the steeply inclined and coarse textured fans and far up the adjacent mountain slopes but has also invaded the more level areas which once produced rice. Okaya in the Suwa Basin is the greatest silk filature center in the world.[5]

Before the development of the American silk market the population of Tosan was small and the stress of making a living was severe. With the greatly increased demand for silk, conditions

[5] Trewartha, G.

changed rapidly. Population grew with amazing rapidity and a new level of prosperity was reached. Mulberry gardens were pushed higher and higher up the mountain slopes and new and thriving filature centers grew up. Today the Tosan District presents one of the most serious agrarian problems to be found in Japan. The mulberry gardens are rapidly receding from the steeper slopes. The low price of raw silk has brought poverty and unemployment. The difficulties promise to become still worse with the growing success of artificial silk.

The future of this area will be solved at least in part through the production of fruit. Apple orchards are already quite widespread and produce fruit of excellent quality. The entire eastern half of the Kofu Basin and the more gradual slopes adjacent are now in vineyards and the grapes from them are justly famous throughout Japan. Something like one-tenth of the hydroelectric power of Japan Proper is developed in the mountain lands of Tosan and more can yet be developed. This, too, may help solve the problems of the future.

THE KWANTO OR EAST OF THE BARRIER DISTRICT

The Kwanto District comprises Japan's largest lowland, the Kwanto Plain, and the surrounding slopes of the Kwanto and Abakuma Mountain lands, to their drainage divides. Three kinds of surface features make up the extensive Kwanto Plain: (1) the old coastal plain, which forms an extensive upland interrupted by wide valleys that are well intrenched below the upland level; (2) a few large and maturely dissected deltas which are associated with this older and higher surface; and (3) the new coastal plain, composed chiefly of the intercalation of unconsolidated sand, clay, and gravel, which since emergence has been separated into many isolated table lands by the wide waste-filled valleys of numerous extended streams. Steep terraces, caused by successive uplifts, characterize the valley profiles. The streams that cross the Kwanto Plain are relatively large and flow on gentle grades. Unlike other parts of Japan they are intensively used for navigation.

The Kwanto District is characterized by hot, humid weather and abundant rains in summer, especially during the typhoon and bai-u seasons, and by clear, sunshiny winters. Snows are light and infrequent. Uncomfortably chilly periods occur in winter with the development of strong, dry winds from the northwest.

In addition to having the largest area of arable land (961,306 cho) of any district in Japan, Kwanto has many other agricultural advantages. It lies within the northern limit of double cropping and the character range of mulberry, tea, tobacco, sweet potatoes, peanuts, mandarin oranges, devil's tongue and other warm climate crops. No other area is so favored by local markets. Here occurs Japan's capital and metropolis Tokyo (nearly five and a half million) and the greatest port Yokohama (nearly one million). Ten other legal cities (shi) and more than 100 secondary towns or cities (machi) lie on the Kwanto Plain or on its borders. All are somewhat industrialized. A dense network of railways, electric lines, and improved roads are supplemented by waterways and tie the rural areas to these domestic markets and to the port of Yokohama. A definite zoning of land use is rapidly developing about the Tokyo-Yokohama conurbation. Especially is this true southwestward in the direction of Kofu where truck gardening, fruit, and flower cultivation and other intensive land uses are displacing the pine forests of the terrace lands.

In general, the pattern of land use is

paddy rice on the lowlands and mulberry, vegetable gardens, dry grains, and pine forest on the uplands. Rice is the first crop and occupies 42% of the total arable area. The quality of Kwanto rice is not of the best, but the yields are high and 14% of the paddy rice crop of Japan Proper is produced here. In addition, Kwanto produces more than half of the dry rice on the northern and northwest portions of the plain. Perhaps the most distinctive agricultural characteristic of Kwanto lies in its preëminent position in barley and wheat production. Half of the barley of Japan Proper and one-third of all the wheat comes from this district. In part this is accounted for by winter cropping on paddy land, but the majority is grown on the dry fields of the diluvial uplands where the cool, moist sprouting season and the hot, dry ripening period greatly favor such productivity. Buckwheat, millet, maize, soy and kidney beans, sweet potatoes, and a variety of vegetables are also grown in considerable amounts on the terrace lands.

More tobacco is grown in Kwanto than in any other district of Japan. It is an upland crop, too, and is favored by rapid drainage and by the high temperatures and abundant and well-distributed rainfall of the growing season. The Sarushima Hills, the Hatano Basin, and the border lands of the Naka River are the chief centers. However, it should be borne in mind that the government tobacco monopoly is largely responsible for the distribution of this crop.

Another characteristic feature of Kwanto agriculture is its outstanding position in silk production. Nearly one-quarter (23%) of the mulberry acreage of Japan Proper occurs here. The sandy well-drained hill lands and terrace tops of the west and northwest part of the plain are the most specialized. Mulberry lands also penetrate far up the valleys of the adjacent mountain lands. The raw silk of Kwanto plus that of Tosan go far to make Yokohama the world's greatest silk mart. Silk weaving is also an important industry in many of the towns of Kwanto.

The animal production of Kwanto is in part an extension of the grazing industry of eastern Ou and in part a reflection of an urban market which has developed more western tastes than any other in Japan. The horses of the volcanic region bordering the northern edge of the Kwanto Plain constitute an old industry. The dairying of the northern part of the district and hog production of Kamakura are new but growing industries.

THE SHICHITO-MALIAUNA ISLAND DISTRICT

No adequate English translation can be given for the name of this district.

The Shichito-Maliauna Island District is composed of a northeast-southwest island chain which is in part at least an insular continuation of the great line of volcanoes which rise above the floor of the Fossa Magna. The Ogasawara (Bonin) Islands, which extend between 25 and 28° N., are composed largely of older Tertiary rocks, but Iwo-jima in the far south and the islands to the north are volcanic. Oshima, the largest and best known of the group, languidly, but constantly, emits smoke. The northern or Idu-Shichito group belongs to the Nankai or South Coast climatic region of Japan and so has an extremely mild climate, with heavy (2,000–3,000 mm.) precipitation well distributed throughout the year. The primary maximum is in June and the secondary is in September. Light frosts and snows occasionally occur. The southern or Ogasawara

group is hotter and somewhat drier. The typhoons are violent and bring heavy downpours. Fishing and the rearing of cattle form the chief industries of the northern islands, while in the Ogasawara Islands bananas and pineapples are grown for the Tokyo market.

THE TOKAI OR EAST SEA DISTRICT

The Tokai District includes the southern parts of the three great mountain lands of Akaishi, Kiso, and Hida, but its agricultural lands are almost entirely confined to the narrow and more or less continuous strip of lowland which extends along the shore of southeastern Honshu between the Kwanto and Ise Bay. This lowland is composed largely of steeply inclined and gravelly delta plains and of diluvial terraces. Across it flow many streams, large and small. Some, such as the Oi, are violently torrential. The high mountains which lie behind the lowland effectively shut off the cold monsoon. Winters are warm and sunshiny and even light snows are rare. Summer rainfall is abundant and maxima occur in September and June.

Not only is the Tokai District favored by natural conditions but it is most fortunate in regard to man-made ones. Lying as it does, between the two greatest population and industrial centers, it is traversed by all of the main highways connecting them. In feudal days its strategic value was recognized and the fiefs encompassing it were held by relatives and friends of the Shogun. Tokai was thus less heavily taxed than other parts of Japan and its development was encouraged. The greatest highway of feudal Japan, the Tokaido, ran along it and connected the Emperor's capitol at Kyoto with that of the Shogun at Edo (Tokyo). Hundreds of sizeable villages and towns grew up along this well traveled road and many became the seats of native industries. With the coming of westernization numerous of these settlements grew into modern industrial centers. The many good harbors along the coast of Tokai gave ready access to world markets.

Paddy rice on the delta plains and specialized dry land production on the terraces comprise the general agricultural pattern of the district. Double cropping is widely practiced and very intensive methods of agriculture are employed. The well-watered alluvial lands have grown fine rice since early times, but the terrace lands have been cleared of their forests and brought into cultivation for the most part since the Restoration. In fact, reclamation is still going on. On the terrace lands about Shizuoka and especially on the great elevated delta of Makinohara is found the largest tea production in Japan. This industry has

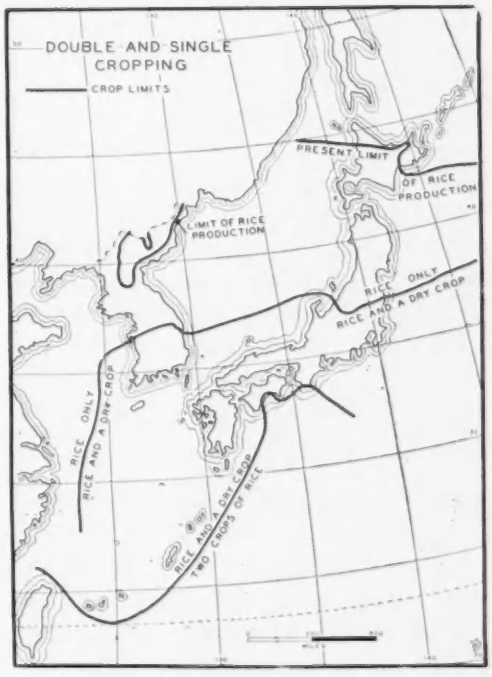


FIGURE 9.—Rice is the chief crop of the Japanese Empire wherever climate permits production. In Hokkaido, as in the Italian Po Basin of Italy, rice production attains the forty-fifth parallel as its northern limit.

been built up for foreign trade, and from the port of Shimizu the United States receives most of its green tea. Some tea is grown as far west as the terrace lands of the Ise Plain. Mulberry, although relatively more important to the people of the mountainous area behind, is produced in larger amounts on the lowland. This industry is concentrated in the area between Hamamatsu and Nagoya. More "daikon" or the great white radish, from which pickles are made, is grown in this district than any other part of Japan and Nagoya and Biwashima are the two most important centers. Greenhouse production centers about Hamanako, and about Kunosan strawberries are grown on south-facing stone walls. An extensive area of pear orchards occurs on the beach ridge at the head of Sugaru Bay. Vegetable gardening is widespread. Wheat and barley are both the product of double cropping.

Again, however, rice is the first crop. The numerous streams which cross the lowland make irrigation quite easy. The long, hot growing season, the copious summer rains, and the fertile soils of the delta plain all favor its cultivation. On the Nobi Plain about Nagoya alone, some 2,000,000 koku (dry measure equal to 5.11927 bushels) of high-grade rice are grown. Other areas are similarly productive, but the density of population is such that there is little surplus.

THE KINAI OR INNER CAPITAL DISTRICT

The capital is of course the ancient, imperial capital of Kyoto. The Kinai District is an area of block mountains and down faulted basins lying between the mighty Kii Mountains in the south, the Chugoku Mountains in the west and the Central Mountain lands of Honshu to the east. The major trend of the fault net here is meridional and most of the resulting uplifted blocks and fault depressions are elongated in the same direction. One or more streams flow into each of these basins and the detrital material they carry has partly or wholly covered the basin floor. Only the northeastern portion of the depression of Osaka Bay has been filled in and forms the Osaka or Settsu Plain. The Biwa or Omi Plain has been filled around the margins but in the center is Japan's largest lake. The Kyoto or Yamashino Basin has an extensive marsh and shallow lake area remaining in Ogura-no-Ike while the Nara (Yamato) and Iga Plains are completely covered by alluvium. Along the margins of each plain occur diluvial terraces. The lower or younger is usually of fine textured materials and is but slightly altered by erosion. The older and upper terrace is generally gravelly, may contain large boulders, and is intricately cut by erosion. Precipitation is relatively low in most of the basin areas because of the surrounding mountain walls. Except for the northern portion of the Biwa Plain, where the north bordering mountains are too low to effectively shut out the winter monsoon, the climate is that of the Pacific Province and most of the precipitation occurs in summer as rain. Summers are very hot and in middle and late summer the relative humidity is exceedingly high (84% in September at Yagi, Nara Plain). Winters are mild and snow is rare.

Man has lived and practiced agriculture on these basin floors for many centuries. He long ago took advantage of every agricultural opportunity offered. He has extended the plains area by cutting back the lower bordering slopes and by removing minor irregularities. He has built hundreds of miles of protecting dikes and drainage lines to control the floods of the typhoon period. He

has constructed an intricate network of irrigation ditches and ponds and has so conserved the waters of the inflowing streams that their natural effectivity, according to Dr. Nasu, has been increased by at least ten times. Countless thousands of wells in places supplement irrigation. On the Osaka Plains they are pumped by small windmills, while on the Nara Plain, the ocean breezes are shut off by the mountains and the wells are pumped by hand. This accumulation of man-wrought changes forms an asset of the greatest importance. No part of Japan is so intensively utilized.

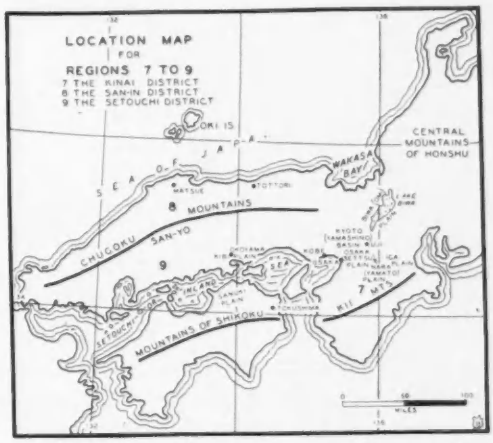


FIGURE 10.—Three major agricultural regions constitute the environs of the inland sea of Japan.

The alluvial basin floors constitute vast paddy fields and the average yield of 2.29 koku of rice per tan is the highest in Japan. Fall drainage and planting of dry crops is practiced more widely than in any other district. Wheat and barley are the most common winter crops on the better drained paddy land while rape seed is the common crop on other land. The narrow dikes separating the paddies are planted in legumes and the scattered plats of dry land produce a succession of quick maturing crops. Fish culture is carried on in the reservoirs and in the moats which surround many of the villages of the Nara Plain. Every possible source of food production is exploited.

The younger diluvial terraces are cleared for the most part and planted in a variety of dry crops. Here intertillage is usually practiced. One common association is mulberry, persimmon and tea. In a few favored localities paddy fields occupy parts of the younger terrace. The upper and older terrace is for the most part in forest, although here and there bamboo and dry crop lands have been reclaimed. Under the old agricultural economy the Kinai District had reached the climax stage of occupancy. The economic rejuvenation which came with Westernization has wrought change in varying degrees depending upon the opportunities for industry and commerce. Osaka has become Japan's greatest industrial city and a nearly continuous fringe of industrial towns and cities border Osaka Bay. Ancient Kyoto now has a population of more than one million and is rapidly being industrialized. Kobe is one of the first ports of Japan and its population is three-quarters of a million. The Nara Plain, on the other hand, is somewhat isolated and although a few factories have been established the change has been relatively small. The Iga Basin is even less altered.

Near the great markets, gardens of truck, fruit, and flowers are highly developed. Improved transportation has allowed some specialization in more distant areas. The watermelons of the Nara Plain, the peaches of the southern part of the Kyoto Plain, and the strawberries of Naruo near Kobe are of this type. A few other areas have specialized productions which are very old, which have been stimulated in recent years. Most important is the high grade tea of Uji, Kyoto Plain. The following table will perhaps help the reader

appreciate the position of Kinai in the general scheme of Japanese agriculture.

Area	% of Arable Land in Paddy	Yield of Rice Per Tan (Koku)	Value of Paddy Land (Yen)	Tan of Arable Land per Agricultural Family
Japan Proper....	58.7	1.833	712	10.9
Nara Prefecture..	77.0	2.285	760	6.9
Nara Plain	90.1	2.500	760	6.6

THE SAN-IN OR "SHADY SIDE OF THE MOUNTAIN" DISTRICT

The San-in District gains its name from its location on the Sea of Japan or northern side of the eastwest trending peninsula of Honshu which extends westward from Wakasa Bay. The south facing slopes bordering the Inland Sea, in contrast, comprise the San-yo or "Sunny Side of the Mountain" area. The crest of the mountain land which forms the backbone of the peninsula lies well north of the center, and the slopes to the Sea of Japan are very abrupt. There are no easy passes across these mountains and consequently San-in is seriously isolated from the more highly developed parts of Japan. Furthermore, there is little level or arable land except for a few small delta plains in the eastern portion and the relatively extensive Hinokawa Plain in the west. There are no important cities in the area and less industrialization has taken place than in most parts of Japan. The coastline is, for the most part, rugged, and numerous volcanoes rise near it.

The eastern portion of San-in belongs to the Sea of Japan Province but is to some extent transitional. Three maxima of precipitation, in the following order of importance, occur, i.e., September, June, and December. The northwest monsoon is unpleasantly cold and brings heavy snows although they are lighter and less frequent and, due to the frequency of rains, they remain on the ground for shorter periods than in Hokuroku. The western part falls in the Pacific Province and experiences but two maxima, i.e., June and September. Winter snows are frequent. Summers are quite hot throughout.

Rice is again the first crop and is planted wherever production is possible. Very little double cropping is practiced, probably because winters, even here, are a bit too long and severe. The "Izumo" type of rice is grown throughout this district and spread from here along the Sea of Japan coast and for some distance inland. It was probably introduced originally from Korea and is admirably adapted to the climatic conditions of the Sea of Japan area. Some surplus is produced in San-in. Mulberry is the second crop and sericulture is virtually the only industry of the dune land in the western end of Tottori Prefecture. So important is the industry here that the family moves out into the outbuildings and gives the entire house to the maturation of the silk worms. Barley and vegetables are next important in acreage but in their yields as in rice and mulberry San-in ranks low among the districts of Japan. Apple orchards are found throughout but are more common in the eastern part, while oranges are grown in the extreme western end. Ginseng cultivation is a highly specialized industry and centers on the lower slopes about Matsue, the largest city in the district. This is unquestionably a Korean importation and like many other features indicates the long and ancient contact of this area with Korea. Cattle and horses in considerable numbers are grazed on the grassy flanks of the numerous volcanoes. Fishing is very important in much of the district and is favored by the lack of resources on the land and by the many small harbors along the rugged coast.

THE SETOUCHI OR INLAND SEA DISTRICT

The Setouchi District includes the downfaulted basin of Japan's Inland Sea and the drainage areas of the streams flowing into it. Northeastern Kyushu is excepted for reasons that will be stated later. The descent to the sea from the Chugoku Mountains of Honshu is by many fault steps whereas the mountains of Shikoku, to the south, present a single, bold fault scarp which marks the median line between the Inner and Outer zones. The Inland Sea, itself, is divided into four open water bodies separated by rather narrow straits and groups of rocky islands. It is these latter portions of the Inland Sea which have won its world-wide reputation for scenic beauty. The shores of the Inland Sea are made up of a fringe of coarse textured and steeply inclined delta plains interrupted by rocky hills and ridges which cut across the plains and sometimes reach the sea. The mountain portion of the district in Honshu is traversed by an intricate network of fault lines which determine the courses of river valleys and account for several interior basins. These lines afford ready access from the San-yo side, but unfortunately do not cross to the San-in District. The countless islands of the Inland Sea may be divided into those with bare, granitic slopes and those which have deep enough soil accumulations to allow agriculture. Surrounded as it is by high mountains on every side, the Setouchi District is one of the driest areas in all Japan. Maxima of precipitation occur in June and in September. Winters are dry, warm and sunshiny. Land and sea breezes are well developed but violent winds are rare. Oppressive calms, the "Yunagi," occur in summer immediately after sunset.

The Inland Sea District like that of Kinai is an area of ancient and mature settlement. Centuries of labor have developed the possibilities of agriculture to a most minute degree. This area, too, had long reached a climax stage of occupancy when Admiral Perry's guns signaled the new era. Irrigation particularly, because of the low rainfall, is most intricately developed. The many streams flowing to the Inland Sea have been tapped above the alluvial level and their waters led through canals. Countless small reservoirs store the surplus river waters and untold numbers of wells supplement the canal irrigation and are used where other forms of irrigation cannot be practiced. Embankments and other means of flood protection have been highly developed. A large proportion of the coastal population supplements its income by the resources of the sea.

The manufacturing industries have found this area favorable for location on account of the dense population and the ease of communication over the sheltered waters of the Inland Sea. Today, many small and large industrial centers dot the shores of the Inland Sea and furnish markets for the agricultural lands. Rice is again the first crop and surpluses are exported from the Bizen and Bocho areas. Most of the rice lands are double cropped and more wheat is produced in this manner than in any other part of Japan. Rye does particularly well in Setouchi and it too follows rice. The rye straw is used in home industries, especially the making of hats. On the marshy fields of the Kibi Plain of Okoyama Prefecture, reeds for "tatami" or floor mats are grown in great quantities. These are planted in December and harvested in mid-July and thereafter rice is planted in the same field. The Sanuki Plain in northeastern Shikoku Island is also an important

producer of reeds. Tea and buckwheat are important crops on the slopes behind the plains. Setouchi fruits are famous. The largest production of tangerine oranges in Japan comes from the eastern end of Shikoku Island. Several of the islands of the Inland Sea are also important producers. Peaches from about Akayama and the Sanuki Plain and pears from about Okayama are marketed widely in Japan. The plain behind Tokushima in Shikoku was widely known for its indigo. The land is now largely in mulberry. Sweet potatoes, tobacco, and mulberry are important crops on the dry lands of both the main and smaller islands. In fact, in the area, unlike Kinai, slope lands are cultivated often to the very tops. Grazing is important in the rougher lands and helps to make Kobe the largest stockyard center and Hiroshima an important meat canning center. In addition to the fishing industry, especially the "tai" or sea bream fisheries, and the employment in water transport, nine-tenths of all the salt produced in Japan comes from the Inland Sea. Shallow and rectangular shaped salt ponds modify the coast line for considerable distances.

THE NANKAI OR SOUTH SEA DISTRICT

The Nankai District includes the maturely dissected mountain lands of high relief of the Kii Peninsula and the southern half of the island of Shikoku. In general high mountains occur even near the coasts and steep slopes descend abruptly to the narrow coastal lands. Little sedimentation has taken place and even the larger rivers have built but small delta plains. The Kochi Plain at the head of Tosa Bay in Shikoku is the outstanding exception. The southern end of Kii and the two southern extensions of Shikoku are fringed by narrow marine terraces in step arrangement. Farther north the coasts are characterized by submerged and sea-filled valleys. The interior valleys are, in most places, deeply intrenched meanders and have little, if any, flood plains.

Nankai is one of the rainiest areas in Japan. The high mountains abruptly intercept the moisture bearing winds and cause heavy summer rains. On the southern slopes of Kii as much as 4,000 mm. is recorded. Throughout precipitation exceeds 2,000 mm. There are two maxima, i.e., June and September respectively. Heavy snow accumulations occur during the winter months on the higher mountain slopes. Especially is this true in the mountains of Shikoku. The lowlands, however, experience warm winters and palms and other tropical plants grow here.

Nankai is nearly completely isolated by land from the rest of Japan and its agricultural resources are most meager. In the mountains a large part of the livelihood of the small population is derived from lumbering while along the coasts a large fraction of the people are partly or wholly employed in fishing. One very noticeable feature in the agricultural landscape is the small percentage of the arable area which is in paddy rice. Only on the Kochi Plain of Shikoku is there any large production. On parts of this plain and on a few other south-facing smaller plains two crops of rice are secured from the same field in a year. Buckwheat, rye, and barley are produced as a second crop on paddy lands and also are planted on the terrace tops and lower slopes. Sweet potatoes are widely grown as dry land crops. Mulberry and vegetable gardens are important on the more gradual slopes. In fact, slope agriculture is, in places, nearly as well developed as in the Inland Sea area. The large acreage of wax trees in south central Shikoku represents almost the

only specialized agriculture in the district.

THE KITA OR NORTHERN KYUSHU DISTRICT

The Kita-Kyushu District includes two quite different and distinct landform divisions. Near the center of northern Kyushu is a triangular area, with its apex to the south and its base along the northwest shore, of block mountains and fault depressions. Here are found block mountains of various trends separated by extensive fault depressions, most of which are waste-filled. East, west, and south of this triangle is an enclosing volcanic land which rises out of and almost completely buries the western extension of the Setouchi or Inland Sea depression. A variety of volcanic forms are found, including several types of volcanoes and lava plateaus in varying stages of dissection. One northern shore of the eastern volcanic area lies in the coastal plain of Buzen.

The eastern portion of the district belongs to the Inland Sea climatic region, but receives more rainfall than the areas farther east. The western part falls in the northern Kyushu region which is wetter and warmer than that of the Inland Sea.

The Inland Sea coast of Kyushu is in many respects similar to the Setouchi District. Salt beds occur along the shore and mandarin orange groves are common features of the landscape. Wax trees, too, are planted on the dikes separating the paddy fields on several of the plains. An outstanding agricultural difference, however, lies in the fact that the backing slopes are volcanic, not granite, and slope cultivation is not practiced. Instead, the volcanic flanks, especially where they are not covered, carry good grasses and are used for the grazing of cattle and horses. Neither is slope cultivation common in the central area of block mountains, but in the western volcanic area, where alluvial lands are small and scattered, slope cultivation is intensively practiced. Particularly is this noticeable on many of the small off-shore islands. Here fishing is the great industry and sweet potatoes, vegetables, soy beans and rye supplement the earnings from the sea.

Rice is by far the first crop and occupies nearly three-quarters of the arable area. Double cropping is generally practiced, which accounts for the large production of rape seed, rye, and wheat. The most marked concentration of rape is on the plains about Fukuoka and the district as a whole far exceeds any other in this production. In both wheat and rye production, northern Kyushu stands among the leading districts. The production of German millet is exceeded only by southern Kyushu. Mulberry is scattered throughout the district, but is not of great consequence except on the southwesternmost plain about Kumamoto. In the south central portion of the district is Mount Aso, a shield volcano of enormous size, in the center of which is a great caldera. Numerous cones occupy its interior and among them is Naka-dake which constantly emits smoke. In spite of this some 70,000 people live within this caldera and the level parts of its floor are intensively cultivated in paddy and dry crops. The ash covered flanks of Mount Aso are used as pastures and for the cultivation of dry crops. Here, the only marked concentration of maize production in Japan Proper is found.

The plains of Northern Kyushu have been settled for untold centuries. This area has had also the longest and most intimate contacts with China. Consequently, a most mature stage of occupancy had been reached before the Resto-

ration. In addition, Japan's greatest coal fields occur in northwestern Kyushu and account for the great and relatively recent growth of industry in this area. Moji is the chief port of entry for raw materials and many industrial towns and cities occur near it. This has created an excellent market for both food stuffs and raw materials. The predominance of rape seed cultivation in this district is largely explained by the demand created by local industries.

THE MINAMI OR SOUTHERN KYUSHU DISTRICT

The Kyushu mountain land, which forms a continuation of the high mountains of Shikoku and Kii, together with the ash plateaus, volcanoes, and granitic and Mesozoic protrusions of southernmost Kyushu comprise the Minami-Kyushu District. Alluvial areas are exceedingly few and small and only the coastal plain of Hyuga on the Pacific side offers any considerable area of low lying plain. There are also a number of fairly wide river valleys. The bulk of the agricultural land, however, is confined to the ash plateau.

The climate of the plateau and lowlands is similar to that of Kii and southern Shikoku and is characterized by warm winters and long, hot summers. Precipitation is heavy (2,000–3,000 mm.) and occurs chiefly in summer, with maxima in June and September. Even light snows are rare. The typhoon is particularly frequent and destructive in this district.

Southern Kyushu is perhaps the most isolated from the main currents of Japanese life of any district. The great mountain barrier which divides Kyushu effectively shuts it off to the north. Ready access by water to the south has led to a long and intimate contact with the Loo Choo civilization. Many of the customs of southern Kyushu differ from those in other parts of Japan. The dialects can hardly be understood by other Japanese. Some claim even a physical difference in the population. The absence of land fit for rice culture and the peculiar qualities of the ash plateau soils leads to a different agricultural pattern than is found elsewhere. The absence of local urban markets and the isolation from outside markets leads to a largely sustenance economy.

Paddy rice is, of course, the preferred crop but only about one-third of the arable land can be so employed. This is much the lowest proportion of any district. Furthermore, neither yields nor quality equal the average of Japan Proper. Double cropping is generally practiced and in the extreme south two crops of rice are secured in a few small areas. The dry land crops are by far the most important. Southern Kyushu is the land of the sweet potato. It was introduced into Japan from Ryu Kyu through this district. In Ryu Kyu the sweet potato is called the Kara or Chinese (or foreign) potato. In southern Kyushu, it is called the Ryu Kyu potato and in other parts of Japan it is the Satsuma (old province of Kyushu) potato. Few crops have left such a definite story of their migration. The sweet potato is particularly adapted to the coarse textured, loose and acidic soils of the ash plateau. The sweet potato is the poor man's food, but it always yields a crop and in the feudal days of regional famines, the people of southern Kyushu always ate. The production about equals that of the Kwanto District, the first producer, but in terms of arable land the sweet potato is three times more important in southern Kyushu. In terms of total value of production, it is proportionally far greater. The dry rice acreage is second only to Kwanto.

Southern Kyushu is first in the production of German millet and competes with Ou for first place in buckwheat production. Soy beans, wheat, and rye are secondary but locally important dry land crops. Barley is intensively grown on the slopes of Mount Ikeda in the far south. The "biwa" or loquat of the slopes of the volcano Sakurajima are the finest in Japan. The "daikon" of the Sakurajima are the largest and most famous in the Empire. A little tea is grown for local consumption. There is some mulberry but in acreage only the Kinai District is less important. Tobacco is the great money crop of the ash plateau and is well adapted to the ashy soils. The high, steep roof of the rural house is largely to allow attic space for drying the tobacco leaves.

AGRICULTURAL OCCUPATION OF HOKKAIDO[1]

D. H. Davis

HOKKAIDO, the northernmost of the four main islands of the Japanese Empire, is a region with rigorous winters and heavy snows: climatic conditions very different from those of the densely populated areas of southern Japan. For many years, and until essentially all the arable land of the southern islands had passed into use, Japanese had little interest in this northern island. Except for seasonal occupation by fishermen, there were few Japanese who made it their home. The aboriginal inhabitants, the Ainu, dependent almost exclusively upon hunting and fishing for a livelihood, comprised the bulk of the sparse population and there was little or no development of agriculture. The steadily increasing population and the lack of a satisfactory outlet elsewhere for the surplus population of the southern islands have of late years focused Japanese attention on Hokkaido and have led to its agricultural occupation as a means of solving in part the serious problem of overpopulation which confronts Japan.

Occupation of Hokkaido has resulted from directed immigration. The settlers have been aided and subsidized by the government, particularly by liberal land grants, to induce them to move to Hokkaido. This encouragement of immigration by the government has been prompted by the desire to establish colonies of Japanese in Hokkaido as insurance against Russian encroachment from the north as well as by the necessity of providing an outlet for the surplus population of the southern islands.

Governmental encouragement of immigration has been necessary because of the disinclination of Japanese to leave the southern islands despite the density of population and the accompanying difficulty of making a satisfactory living from agriculture on the small amount of arable land available. This unwillingness to move results from the unattractiveness of Hokkaido to the average Japanese who dislikes the task of subduing a new region, particularly one in which the winters are both long and cold. An almost equally potent factor deterring immigration is the disinclination of most Japanese to separate themselves from the established social order and the community of which they are a part.

Despite active governmental interest in emigration to Hokkaido, the movement of population into the northern island has at no time been rapid and at the present time the rate of movement is slowing up appreciably. This is because practically all the land which is easily accessible and which can be brought into profitable agricultural production without the expenditure of much labor and money has now passed into use. From some sections of Hokkaido, particularly in the more recently occupied areas of lesser agricultural promise, emigration may, in certain years when weather conditions have been particularly unfavorable, balance immigration.

Rail Construction and Agricultural Occupation

The early settlement of Hokkaido was based on fisheries and was, therefore, confined to the seaboard. As agricul-

[1] The field work on which this study is based was supported in part by the Fluid Research Funds of the University of Minnesota.

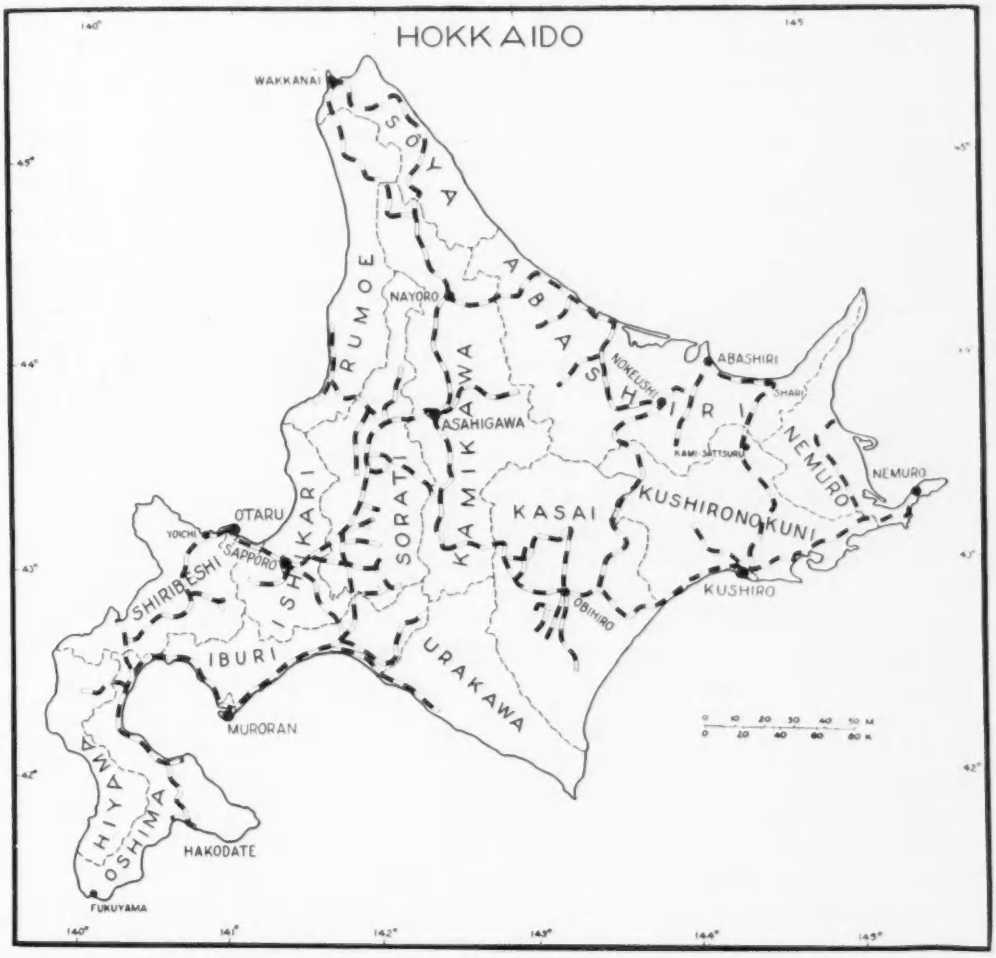


FIGURE 1.—Map of Hokkaido showing the location of all rail lines and places mentioned in the text.

ture assumed some importance, arable land in the areas immediately tributary to the seaports passed into use, particularly in the Hakodate Peninsula which was settled at an early date. From these early nuclei of agricultural settlement farms spread inland, occupying the most easily developed arable land, particularly on the uplands. In the absence of an effective transportation system such development was necessarily confined to restricted areas and to the peripheral portions of the island, mostly in the south and southwest.

Between 1880 and 1885, a rail line was constructed from Otaru to Sapporo, and by 1890 this line had been extended to serve other portions of the Ishikari Plain, the largest of the plains areas of Hokkaido and excellently adapted to pioneer occupation because so large a fraction of its surface is upland, thus making unnecessary the construction of either drainage or irrigation ditches.

Within the next decade, rail construction in the Asahigawa Basin and in the other intermontane valleys which lie between the two main north and south mountain ranges of Hokkaido opened up large additional areas of arable land for the incoming settlers. In these newly opened areas, both topographic and cli-

matic conditions made rice production possible and today these regions rank first in importance among the rice-producing areas of Hokkaido.

By 1910 the Tokachi Plain had rail connection with the seaboard to the south at Kushiro and to the west by way of Asahigawa and Sapporo. The area thus opened for settlement was largely upland. Though having a somewhat less favorable climate for agriculture than some of the areas of earlier occupation, the arable land all passed into use within a short period of time.

During the ten year period ending in 1920, some smaller and less desirable areas were opened for settlement by additional rail construction, and between 1920 and the present date, construction of spur lines and the bridging of gaps between existing spurs have rendered readily accessible practically all the potential agricultural land of Hokkaido. Such arable land as remains to be supplied with transportation facilities is in small, discontinuous tracts, most of which are located in parts of Hokkaido where climatic conditions are relatively unfavorable for agriculture. In the recently opened areas, this fact reflects itself in the slow progress of settlement. Today, the end of immigration is in sight with the exhaustion of the possibility of opening up additional tracts of considerable size and promise for settlement.[1]

A Planned Agricultural Economy and the Foreign Influence

Agricultural settlement of Hokkaido, with its short frost-free season and rigorous winters, introduced problems new to Japanese agriculture. This fact was recognized by the Japanese Government and foreign advisers, particularly Americans, were brought in to assist in formulating plans for the most effective use of the land and in advising as to the proper crops to be grown. The fact that the area was largely unoccupied simplified the problem of introducing a planned agricultural economy by obviating the necessity of displacing one existing previously and was an important factor in determining the present character of Hokkaido agriculture. As results of this planning, land holdings in Hokkaido are unfragmented and of liberal size; crops and agricultural practices are suited to the local conditions; building construction is modified to some extent by foreign influence and the farmers today benefit from Agricultural Experiment Stations, Experimental Farms and Model Farms.

The Agricultural Experiment Stations are devoted to experiments in plant and animal breeding. They raise much larger crops than do the farmers on equal areas, individual farmers in general securing only about 60 per cent of the experimental yields. One of their most notable achievements has been the perfection of a variety of rice which will mature in a 90-day frost-free season, thus making rice production possible in practically all parts of Hokkaido.

The Experimental Farms attempt to develop the best practices for specific areas and agricultural industries. The Makomonai Stock Breeding Farm about six miles south of Sapporo, for example, specializes in the breeding of fine stock: horses, cattle, swine, poultry and rabbits and in the production of crops for the associated animal industry. Crops raised on the 1,000-acre farm in 1931 embraced the following: hay crops (timothy and clover, orchard grass, sweet clover, and some alfalfa), 80 per cent of the acreage; dent corn for silage, 5 per cent; flint corn for grain, 5 per cent; sugar beets, 1 per cent; stock beets and carrots, 1 per cent; potatoes, 1 per cent. Milk and butter

[1] For a more detailed description of the spread of settlement as influenced by rail construction, see the article by the author in the *Geographical Review*, July 1934, pp. 386–399.

were produced and sold and the young stock bred on the farm was disposed of to farmers to improve the breeds. The Model Farms demonstrate the best farm practices for the benefit of the farmers of the immediate vicinity. Much has been done by these various agencies in improving farm practices; much more remains to be accomplished as Japanese are notoriously conservative farmers and slow to adopt new practices.

TOPOGRAPHY AND SOILS

Like the other three main islands of Japan, Hokkaido is mountainous in the interior; a series of terraces resulting from uplift and separated from one another by only a few feet in elevation generally borders the coast. The main mountain axis, consisting of two roughly parallel ranges, the highest peaks of which attain elevations of nearly 7,000 feet, trends north and south. From these two main ranges, spurs extend transversely across the island, forming an intricate pattern of ridges and intervening valleys, so that not more than 15 per cent of the island is topographically suited for agricultural use.

The agricultural area of Hokkaido consists of a few discontinuous and widely separated plains areas of considerable extent and more numerous, though areally less important, attenuated strips of level land bordering the stream courses. Everywhere the soils are derived from volcanic ash, as numerous eruptions have veneered terraces, uplands and other land surfaces with this type of material. Even the peaty alluvium is derived from worked-over ash plus much organic material.

The peat and peaty soils of Hokkaido, which occasionally reach a thickness of as much as fifty feet, comprise a very large fraction of the soils in agricultural use. They are of two types: the moor peats, not in use and probably valueless for agriculture, and the lowland peats which are used mainly for rice production. The peat soils require heavy fertilization and the same is true for most of the upland soils. The principal fertilizers used are: superphosphate, ammonium sulphate and soy bean cake.

The average density of population in Hokkaido in 1930 was 76.7 persons or 14.1 households per square mile; the average density of population per square mile of arable land was 511.5 persons or 94 households. This represents 1.25 acres of arable land and less than .9 acres of cultivated land per person. Though part of the population is supported by fishing, lumbering, mining, trade and manufactures, it is obvious, that considering the climatic limitations and the relative poorness of much of the soil, no great expansion of the agricultural population of Hokkaido is possible.

CLIMATIC CONDITIONS

Until rather recently most Japanese held erroneous beliefs as to the severity of the climate of Hokkaido. They thought of the island as having such long, cold winters that only limited opportunity for man existed whereas such is not the case. Such beliefs resulted from reports based on the superficial observations of occasional visitors who, impressed by the striking differences between winters in Hokkaido and southern Honshu, unconsciously exaggerated actual conditions in their descriptions. Impressions as to climatic conditions gained in this manner enjoyed wide circulation and long acted as an effective deterrent to immigration. Though increasing knowledge of actual conditions has dissipated these earlier, erroneous beliefs to a large extent, they down slowly, as few Japanese know Hokkaido from personal experience; to most it is still a far away and little known region.

Only short-period climatic records are

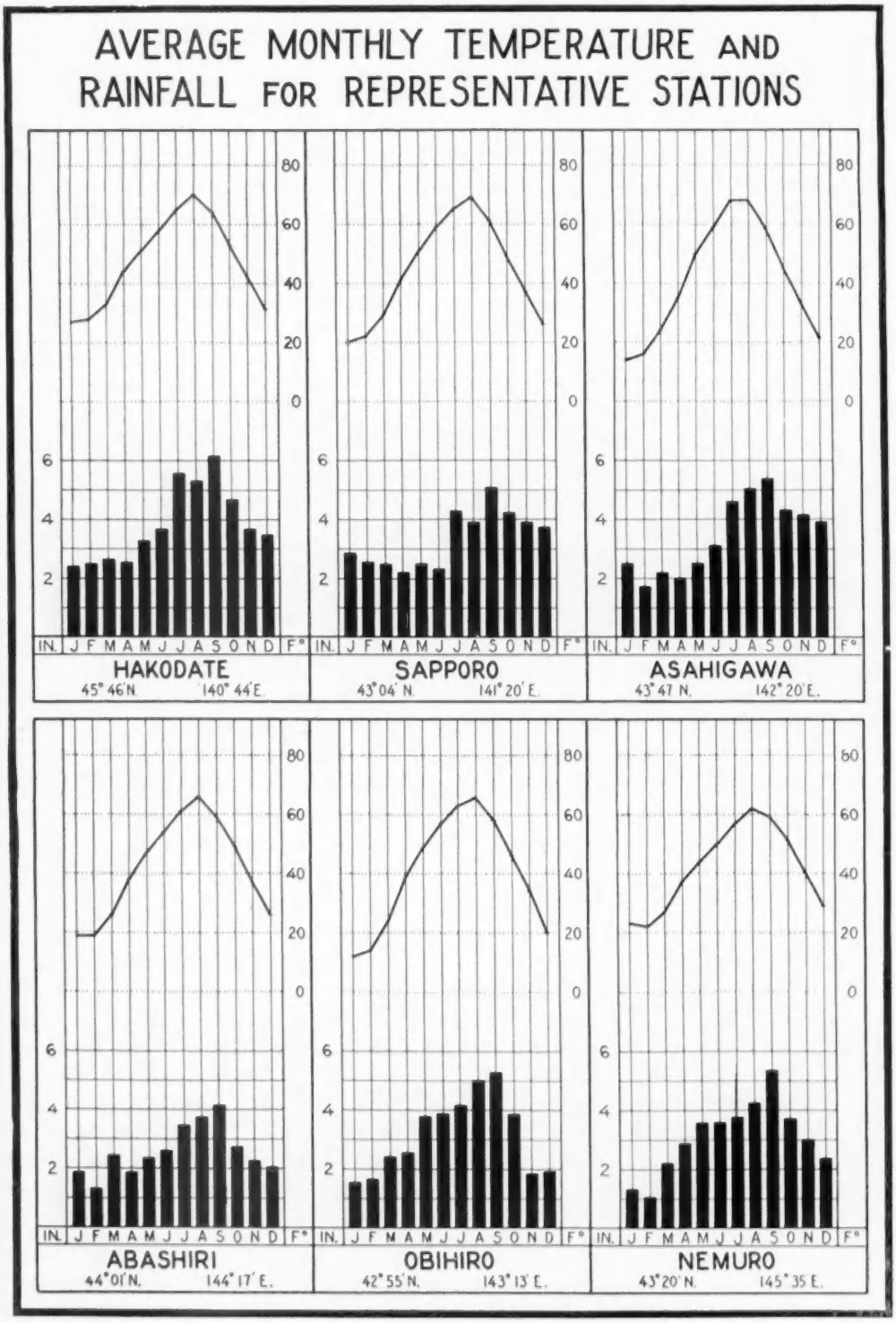


FIGURE 2.—Climatic Data: Precipitation and Temperatures for Selected Stations.

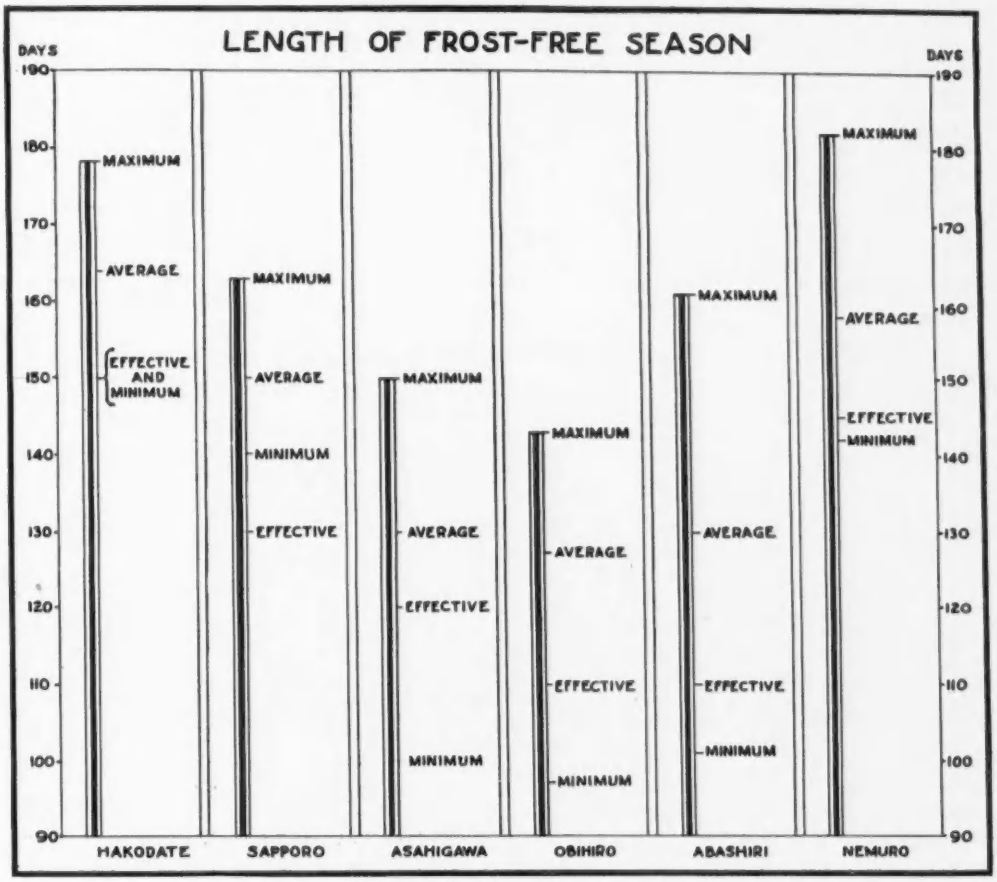


FIGURE 3.—Length of the frost-free season for selected stations.

available for a few stations, but they are sufficient to furnish a fairly adequate picture of conditions and to prove, that for certain types of agriculture, the climate is not unfavorable despite the short frost-free season and the long, cold winters. In some parts of Hokkaido, cloud, fog and low temperature efficiency handicap production; in other portions, there is a somewhat important drought hazard. For most of the area topographically suited to agriculture, however, climatic conditions allow the use of the land for crop production.

The winters of Hokkaido are much like those of northeastern United States. Freezing temperatures may be expected shortly after the first of October and snowfall is general late in the same month; the ground is frozen solidly all winter and does not thaw out until late in the spring. The coldest season is from the middle of January to the middle of February, temperatures during that period ranging from 10 to 30 degrees Fahrenheit, with minimum temperatures much lower. The warmest summer months are July and August with normal maximum temperatures of 80 to 85 degrees Fahrenheit, though on occasional days the thermometer records temperatures as high as 95 degrees. August is ordinarily slightly warmer than July. The annual range of temperature varies from 40 to as much as 55 degrees, the intermontane basins having the maxi-

mum and seaboard locations the minimum of change of temperature from summer to winter.

The frost-free season varies greatly in length both from place to place and from year to year in the same place. This variability in length from year to year greatly reduces the effective length of the agricultural season, or the length in four-fifths or nine-tenths of the years, and in certain areas, constitutes a serious handicap, especially where associated with low temperature efficiency during the productive season. In the Tokachi Plain, for example, the last frost in spring may occur all the way from April 30 to June 27 and the first frost in fall varies in the date of its occurrence from September 16 to October 9. This variability in time of occurrence at both ends of the frost-free season may be so great as to make the effective length of the frost-free season in certain areas even less than the minimum length for the same area.

Precipitation is lighter in Hokkaido than in the southern islands; in none of the agricultural areas does it exceed 45 inches and in the northeast the amount received during the year does not average greatly in excess of 30 inches. In occasional years, there may be even less than this amount. In the areas of lighter precipitation, as the Nokeushi District, departures from the normal are not unusual and may be disastrous to crops. The seasonal distribution of the precipitation is much the same as in other parts of Japan and favorable for agriculture, there being two maxima: one in the early summer and another in the fall.

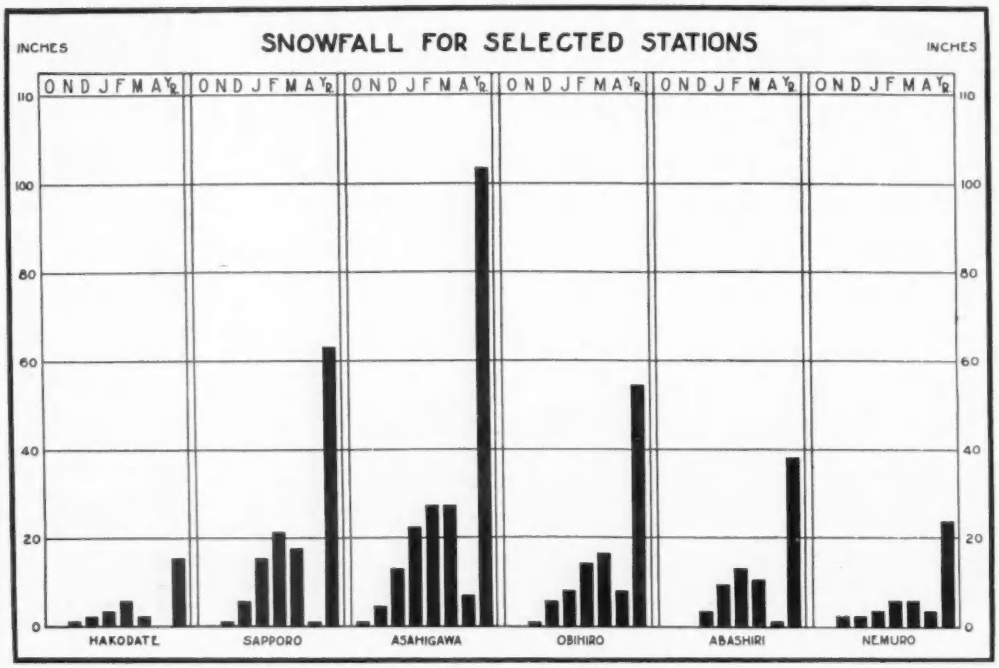


FIGURE 4.—Snowfall record for selected stations.

Snowfall is very heavy in most parts of the Dô. In Asahigawa, the snow may reach to the eaves of the low, one-story houses, completely blocking the narrow streets though the eaves of the houses project sufficiently to keep the ground under them free from snow, thus affording a narrow passageway for pedestrians. Throughout the island the snows are sufficiently heavy so that it is

common practice to place balks or heavy timbers on the roofs of the railway stations and other large buildings to prevent the snow from sliding.

The first snows melt, but after the end of November the snow called the "ne-yuki" or "root snow" by Japanese remains on the ground, increasing in thickness in some districts to as much as four or five feet, though the average accumulation does not exceed two feet in depth. The south and southeast portions of the island have the lightest snowfall; the interior basins and the mountain ranges receive the maximum amounts.

AGRICULTURAL PATTERNS AND PRACTICES

Farms in Hokkaido are approximately four times as large as those of the three southern islands and they are not fragmented. In the distribution of land to immigrants, the Hokkaido Government made the allocations of sufficient size to attract settlement and to provide an adequate basis for support by Japanese standards. This, together with climatic conditions which render only one crop a year a possibility and thereby make larger farms necessary, explains the size of the land holdings. In many places, however, especially in the important rice-producing areas, the individual fields or paddies are not appreciably larger than in the rice-growing areas of the south, though this small size appears to be entirely unnecessary and accompanied by certain manifest disadvantages.

Farm houses are generally located on the individual farms. They are frequently arranged in "strassendorfs" along the main highways, but even then they are located on individual land holdings, and off the main highway, individual farm houses dot the landscape. Farm buildings usually constitute a much smaller fraction of the total farm value than in the southern islands as they frequently represent only temporary shelters erected by incoming settlers, not yet replaced by more permanent structures. In the areas of longer occupation, there has been a considerable replacement of such temporary structures with buildings which in surficial appearance reflect the American influence which colors so much of Hokkaido agricultural occupation. In areas of upland agriculture, silos are rather common because of the considerable importance of the animal industries, particularly dairying, and the American influence to which reference has been made.

Draft animals are used to a much greater extent than in other parts of Japan and horses particularly are much more important numerically than to the south. This is true even in the important rice-producing areas as the paddies are not water-covered and horses can be used to advantage for plowing in the cooler climate. Horses are driven in the American manner and the English words "whoa" and "back" are used to direct them.

Though there is no large-scale production as in the United States, farm machinery is used rather extensively in Hokkaido by comparison with conditions in other parts of Japan. The farm machinery is of American type, but at the present time of Japanese manufacture. On the Experimental Farms, the equipment is modern in every respect and the use of such equipment is becoming more general on the farms of the individual producers. There is much less intensive fertilization of soils and working over of the earth by hand than in the south resulting from the absence of surplus labor and large quantities of easily available night soil, in place of which fish and farm wastes such as manure and rice straw are used.

Agriculture in Hokkaido is of two types: upland and lowland or "paddy"

agriculture. In certain areas, either of these two types may involve the production of a saleable surplus; in others, the agriculture may be of a purely subsistence type; in still others, agriculture supplements or is supplemented by fishing or lumbering. Much of the agriculture of Hokkaido, particularly of the lands still to be occupied, must permanently be of this last type. It is understood that the Hokkaido Government recognizes this fact and that plans for land use contemplate the integration of agriculture and lumbering operations to preserve the future possibilities of such sub-marginal agricultural areas.

Only one crop per year can be grown in Hokkaido with its short frost-free season and its long, cold winters. This is true for all areas in the island. On the lowlands, this crop is rice; on the uplands, it may be any combination of oats, potatoes, beans, peas, rye, buckwheat, wheat, barley, flax, hay crops or a long list of other crops of much lesser importance in the agricultural economy of the area.

Agricultural occupation in an important way did not begin until subsequent to 1880. Areas such as the Ishikari Plain and the Asahigawa Basin which were settled at that date or shortly thereafter have now passed completely into agricultural use with the possible exception of a very few poorly drained portions and today present pictures of settled agricultural occupation. In the areas of more recent rail construction and settlement, frontier conditions still exist; lumbering operations are in full swing; cut-over land is being cleared for crop production; stumps still stand in the fields in both uplands and lowlands. These areas which are now being occupied are much less desirable and hold forth much less promise for the future than do those of earlier settlement. They are of small areal extent, attenuated in form, less accessible to markets and they are located in areas with less favorable climatic conditions and with less varied and less profitable crop possibilities. In many cases, the probability of their remaining attractive to settlers will be determined by the feasibility of integrating agriculture and lumbering as has been stated previously. If such a planned economy can be introduced, paralleling, rather than subsequent to, occupation with later abandonment as has been the history of land occupation of such areas in this country, it will be unnecessary later on to provide for the effective use of such cut-over lands. Land use in Hokkaido provides an interesting situation in that it is possible to study the various stages of occupance as they now exist coincidentally, something which it is impossible to do for most areas.

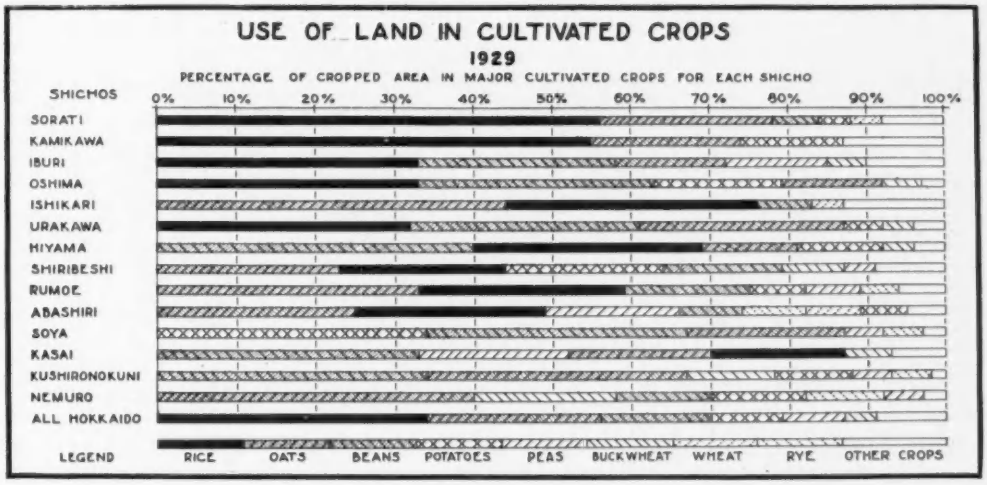
CROPS AND CROP SYSTEMS

As in other parts of the four main islands of Japan, use of the land is limited by topographic conditions, the flat areas of alluvial soils passing into different types of use from that of upland areas with smooth to gently rolling topography. In addition, climatic conditions in Hokkaido introduce another limitation which makes for differences between both crops and crop systems of the northern island and of those to the south. These two factors in combination not only affect the agriculture of Hokkaido as a whole as contrasted with that of the islands to the south but they impose varying degrees of limitation on land use in different parts of Hokkaido. In all, these two factors are responsible for differences which make possible the recognition of three major agricultural regions in Hokkaido.

In the west and southwest, rice is the most important crop, sometimes occupying as much as 60 per cent of the cropped area where topographic conditions are favorable, and in no part of this area

does rice occupy less than 20 per cent of the land devoted to cultivated crops. In this part of Hokkaido, oats rank second, often being of but slightly less areal importance than rice. Other important crops are beans and potatoes.

In the northeast part of Hokkaido, rice decreases in both actual and relative importance, seldom occupying as much as 25 per cent of the cropped land and oats are of about the same and occasionally of even greater areal importance.



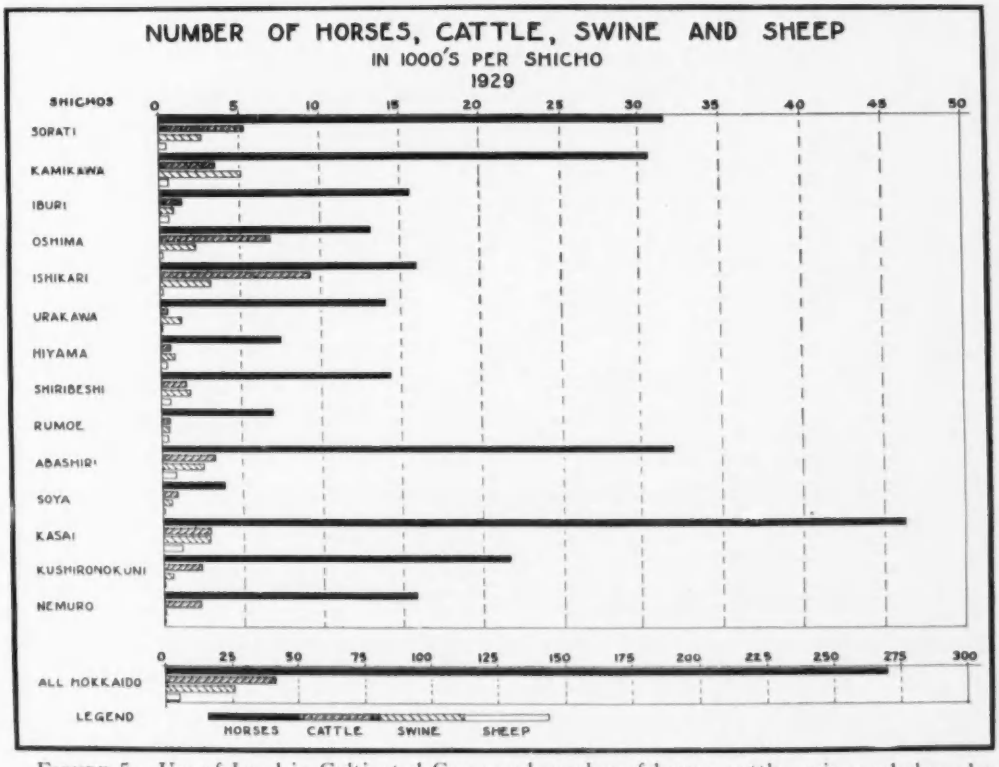


FIGURE 5.—Use of Land in Cultivated Crops and number of horses, cattle, swine and sheep by shichos in 1929.

Beans, potatoes, peas, rye, wheat and some buckwheat are crops of varying relative importance, with beans and potatoes more important than the others.

In the southeast, with much moor peat and cool, cloudy, foggy weather, agriculture becomes of much lesser importance and stock raising, particularly the breeding of horses, dominates the agricultural economy. The principal cereal crop in this area is oats; other crops are beans, potatoes, buckwheat and peas raised on small acreages in connection with the animal industries and in part to supplement income derived from the fisheries. Rice production in this part of Hokkaido is confined to the western portion of the region and the volume of production is small.

INDIVIDUAL CROPS

Rice production in Hokkaido, as elsewhere in Japan, reflects the requirements of Japanese diet, therefore farmers often raise rice even where physical conditions greatly handicap its production and where the cultivation of the cereal does not appear to justify the amount of labor required. In view of this condition, and inasmuch as it is possible to grow rice in all parts of Hokkaido except on the north coast and in the foggy east and southeast, if labor costs are not too high, it

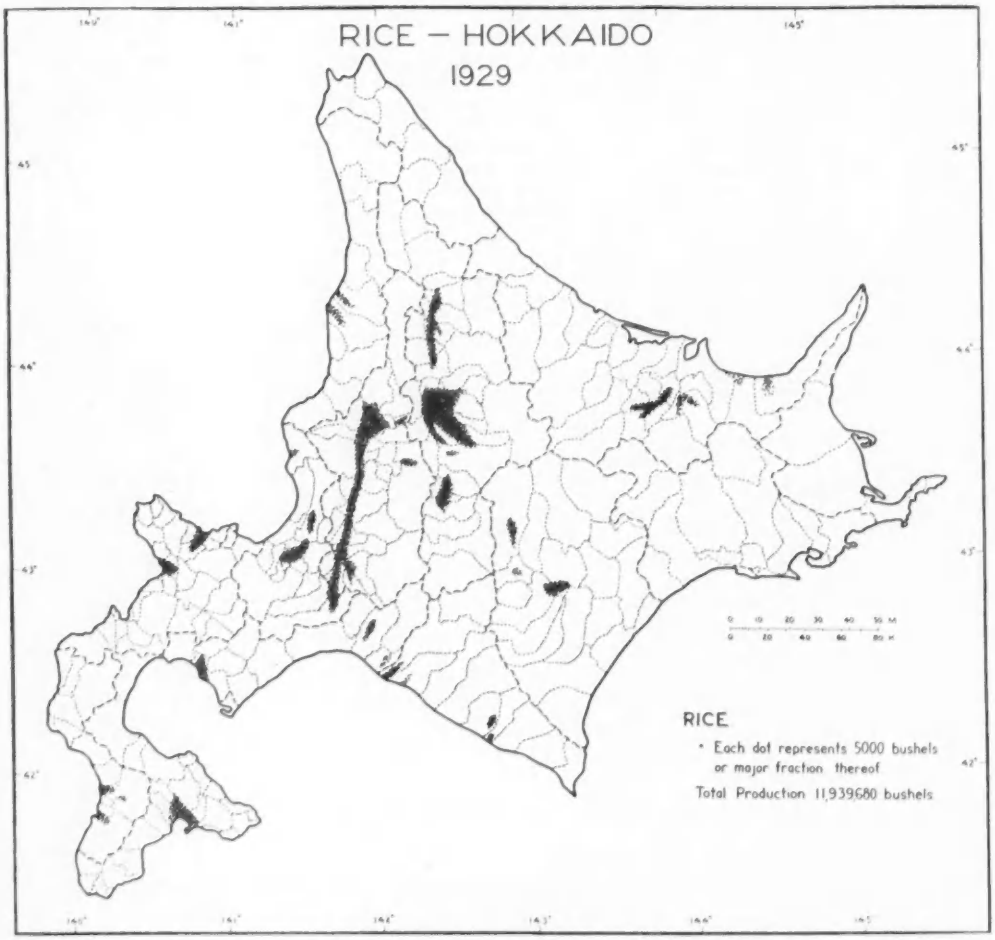


FIGURE 6.—Rice production in Hokkaido—1929.

is the most important cereal crop in the island in areal extent, volume and value of production. Only in those shichos where topographic and climatic conditions render its cultivation an impossibility does it fail to find an important

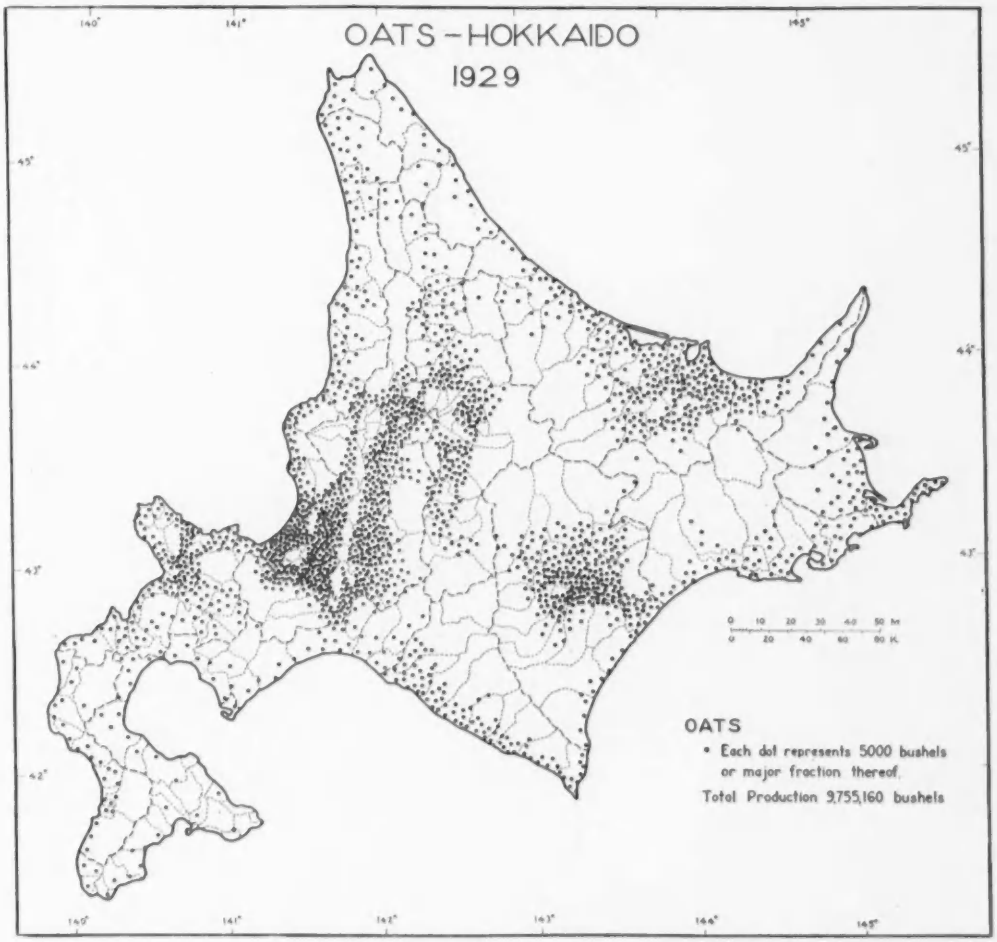


FIGURE 7.—Oats production in Hokkaido—1929.

and often dominant position in the crop system.

Its early production was confined to the southwest of Hokkaido, but the development of a variety which will mature in a 90-day, frost-free season has led to its spread to the north and northeast. By 1909 its cultivation was general in both the Ishikari Plain and the Asahigawa Basin; by 1919 the crop had moved east of the main north and south mountain ranges and was grown in the Tokachi Plain; by the present date it has extended into practically all the areas under cultivation as an important crop on the peat and peaty soils of the alluvial plains. Production of rice on such lands is, according to the experience of both the Experiment Stations and individual farmers, more profitable than the production of other crops on such soils so rice will probably not be displaced from such areas by other crops, especially in view of the increasing population, the greater abundance of labor, and the greater necessity for an intensive type of agriculture.

On the uplands, oats rank first in im-

portance among the cereal crops, being raised on an acreage only slightly less than that given over to the growing of rice on the lowlands. In some areas, oats may be of even greater importance than rice; in all parts of Hokkaido the crop ranks high in relative importance, where stock raising is of major importance, the oats crop ranks high in relative importance. In addition to being raised in connection with the animal industries, oats supply a certain amount of food for the population as oatmeal is in rather general use by Japanese in Hokkaido.

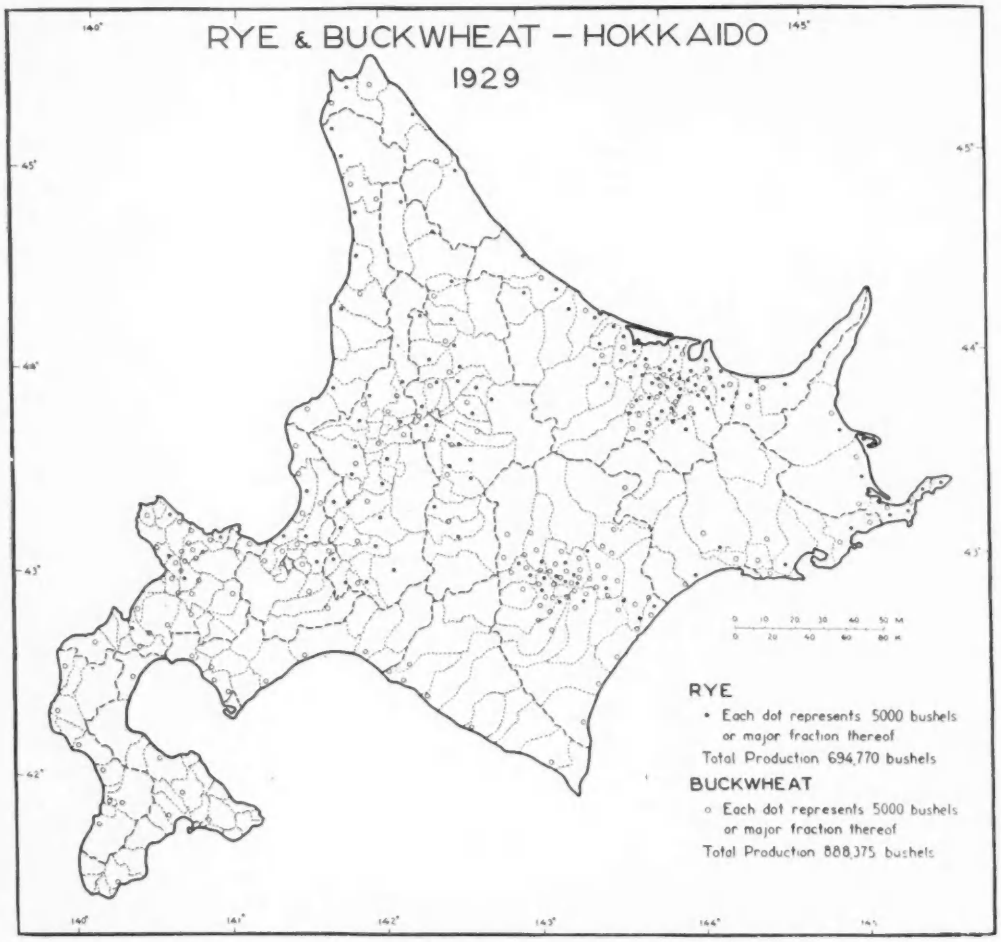

RYE & BUCKWHEAT – HOKKAIDO
1929
RYE
• Each dot represents 5000 bushels or major fraction thereof
Total Production 694,770 bushels
BUCKWHEAT
○ Each dot represents 5000 bushels or major fraction thereof
Total Production 888,375 bushels

FIGURE 8.—Rye and buckwheat production in Hokkaido—1929.

even on the north coast and in the southeast. As early as 1909 the crop was grown in practically all parts of the island; by 1919 the production of oats was important in the Nokeushi District as well as farther to the west; by the present date it is the most widely grown of all the cereal crops though not areally the most important. Oats fit in well with the animal industries, and in those areas Curiously, the English word "oatmeal" is used by Japanese, one of the few English words understood generally in Hokkaido.

The other cereal crops grown in Hokkaido: buckwheat, rye, wheat and barley are produced on greatly varying acreages in the different portions of the island, though the total acreage of any one of the list is not large and the total acreage

for all is less than half that for oats or one third that for rice.

Buckwheat is a crop of some importance in the east half of the island and it is raised as a minor crop in the other agricultural areas. In the Tokachi Plain and in the Nokeushi District it assumes greater importance than elsewhere. In areas are in the east half where climatic conditions favor this crop and handicap the production of others. In both the Tokachi Plain and in the Nokeushi District, rye, like buckwheat, occupies a fairly important position among the cereal crops.

Wheat, the third of the minor cereal

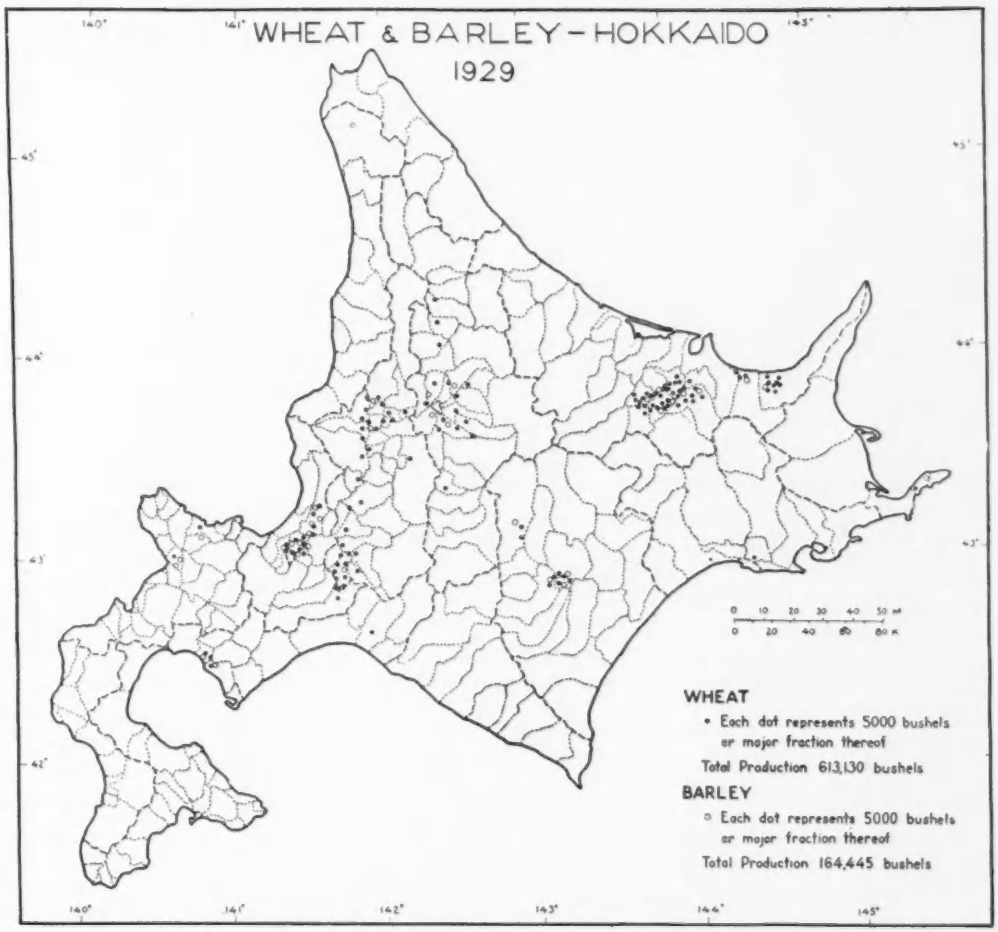

WHEAT & BARLEY - HOKKAIDO
1929
WHEAT
• Each dot represents 5000 bushels or major fraction thereof
Total Production 613,130 bushels
BARLEY
○ Each dot represents 5000 bushels or major fraction thereof
Total Production 164,445 bushels

FIGURE 9.—Wheat and barley production in Hokkaido—1929.

general, it is a new land crop and is displaced by other cereals as agriculture ages in an area. In some parts of the island, buckwheat forms an important item of the diet.

Rye is second in volume of production among the minor cereals. Like buckwheat, it is raised in all parts of the island but the more important producing crops in volume of production, is concentrated in a few areas with the Nokeushi District most important. Other areas are the upland portions of the Ishikari and Tokachi plains, with smaller production in the Asahigawa Basin.

Barley is a relatively unimportant crop with areas of production essentially the same as for wheat. The relatively un-

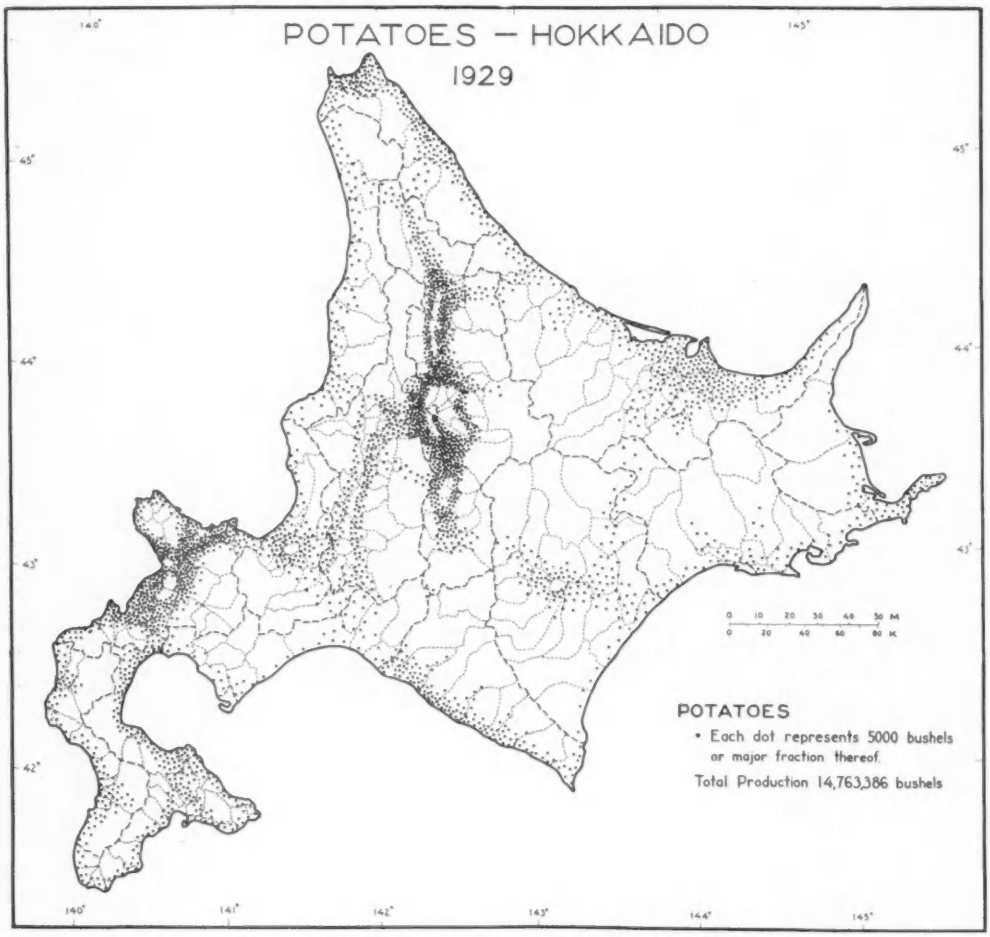


FIGURE 10.—Potato production in Hokkaido—1929.

important position of wheat and barley in the agricultural economy does not result from unfavorable physical conditions as both topography and climate are suitable; it reflects rather the exercise of human choice in crops to be produced.

Potatoes are grown in all parts of Hokkaido and form a portion of the diet of the inhabitants. They are also used as food for stock and constitute the basis for a fairly important starch manufacturing industry, the 1,594 starch mills in existence in 1929 producing starch valued at $2,474,409 in that year.

Beans and peas are grown in all parts of Hokkaido as important crops, being used both as stock food and by the population. There was no marked concentration of the bean crop in any definite area in 1909, but by 1919 the Tokachi Plain had become the most important single producing area which position it still holds. In similar fashion, the Nokeushi District has assumed first place in pea production. Many varieties of both beans and peas are grown, including the soy bean which ranks first in importance. This serves as the basis for an oil extracting industry of considerable proportions and the bean cake finds extensive use on the farms.

Hay crops are of importance only on the uplands. Timothy and clover, al-

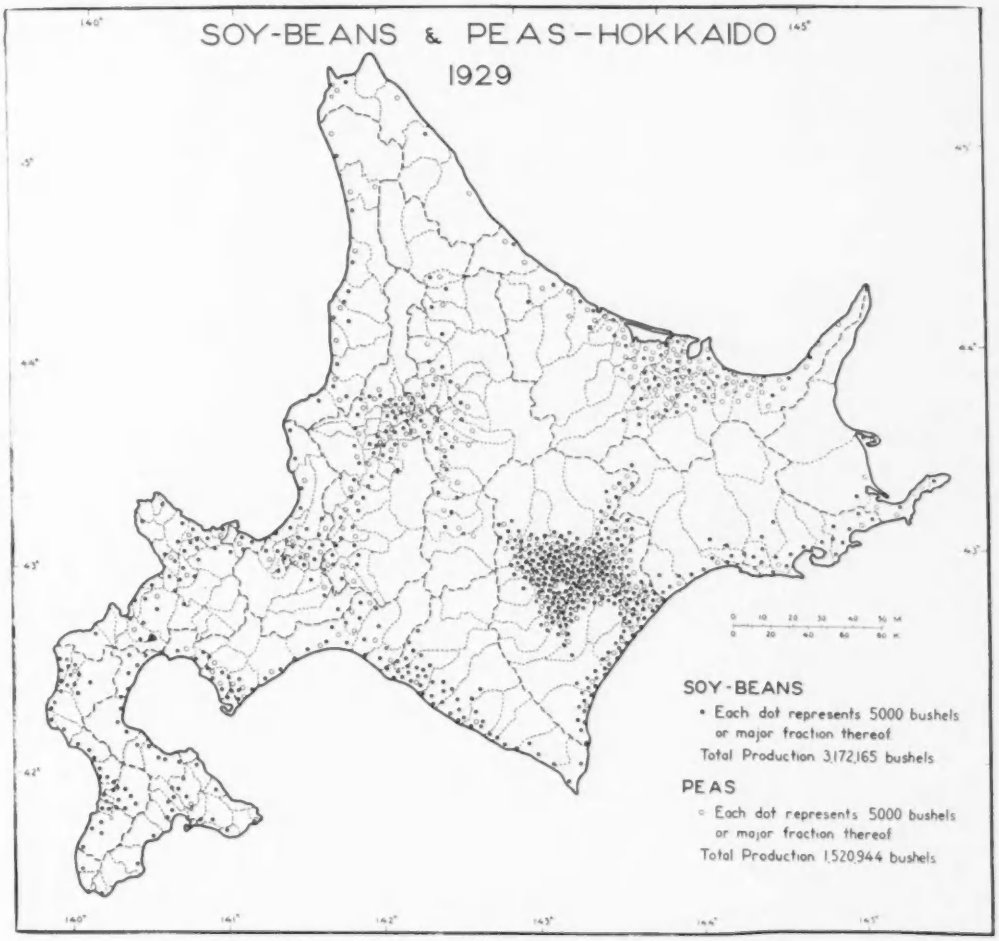

SOY-BEANS & PEAS-HOKKAIDO
1929
SOY-BEANS
• Each dot represents 5000 bushels or major fraction thereof
Total Production 3,172,165 bushels
PEAS
◦ Each dot represents 5000 bushels or major fraction thereof
Total Production 1,520,944 bushels

FIGURE 11.—Bean and pea production in Hokkaido—1929.

falfa, orchard grass and sweet clover are all grown, but as alfalfa and clover do not do well without heavy applications of lime, the other hay crops are raised more commonly.

Minor crops, often of considerable importance locally, embrace sugar beets, flax, hemp, peppermint, and a long list of root and vegetable crops. Of this list, the sugar beet is the most important upland crop, being used both as stock food and as the basis for sugar production, the value of which was $4,637,464 in 1929. Peppermint may be an important crop on the lowlands, as in Abashiri where most of the crop is grown. Its value in 1929 was slightly in excess of that of the sugar production, though the crop is less important than the sugar beet.

ORCHARD CROPS

Orchard crops are not of great importance for the island as a whole, but they locally assume considerable significance in the farm economy. The principal orchard fruits grown are apples, peaches, pears and plums, with apples much the most important of the list. Most of the apple production of Japan proper is localized in Hokkaido, which supplies not only the demand of the southern islands in large part but furnishes as well an export item of considerable importance

in the Japanese-Russian trade between Otaru and the Asiatic mainland.

All fruit trees: apple, pear, peach and plum, are pruned heavily so that the crop can be harvested readily from the ground. The fruit produced is of excellent quality. The apples are fully the equal of most American apples, and they ship well so that it is possible to market the crop effectively in all parts of the Empire.

The total apple production varies between 800,000 and 950,000 bushels, grown mostly in the southwest portion of the island. Of the 1929 production of 822,093 bushels, 42 per cent came from Shiribeshi, Ishikari and Sorati, Shiribeshi alone being responsible for 20 per cent of the total crop. Most of the Shiribeshi production came from the district around Yoichi, the most important single producing area in Hokkaido.

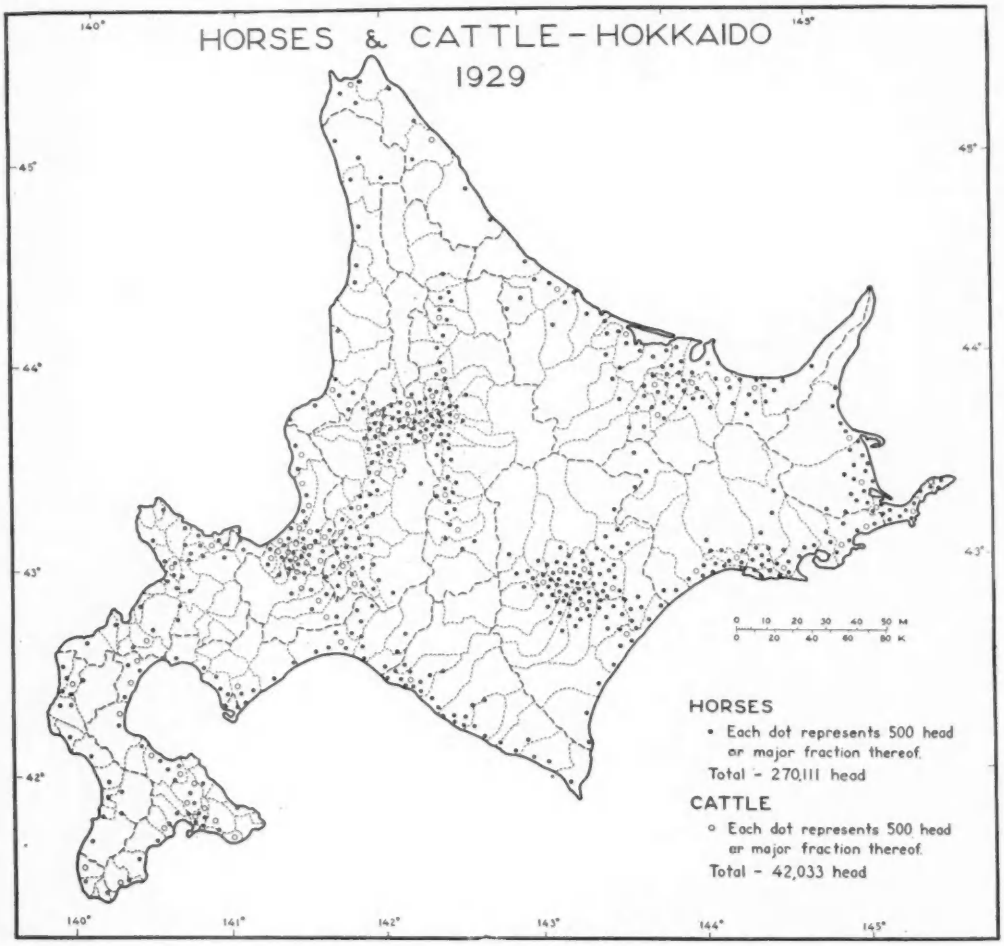


FIGURE 12.—Horses and cattle in Hokkaido—1929.

SERICULTURE

Though wild mulberry trees occur in the Dô, sericulture has made but little progress. During the earlier period of occupation, land was plentiful and the attention of the immigrants was directed to other occupations as the supplementary income derived from silk production was unnecessary. Later, the industry

made a small beginning, based largely on the wild mulberry. In 1930, the production of raw silk and silk floss was valued at $13,000, only a small amount and a measure of the present importance of the production. The Experiment Stations are now distributing mulberry for planting, and with increasing population densities in the agricultural areas, the industry may be expected to assume somewhat greater importance, though not that of central Honshu.

THE ANIMAL INDUSTRIES

The animal industries embrace the raising of horses, cattle, sheep, swine, goats, poultry and rabbits and the production of market milk, condensed milk, butter, cheese and meat. The importance of the industry is increasing rapidly under governmental encouragement, partially as a means of supplementing farm incomes from other sources and partially as a means of encouraging better farm practices in the areas of diversified agriculture.

Horses lead in numbers (270,111 in 1929), being used extensively both as draft animals and as work animals on the farms. They are also raised for export to the southern islands, many finding their way into use in the Imperial Army. The Govermental Breeding Farms have attempted to improve the

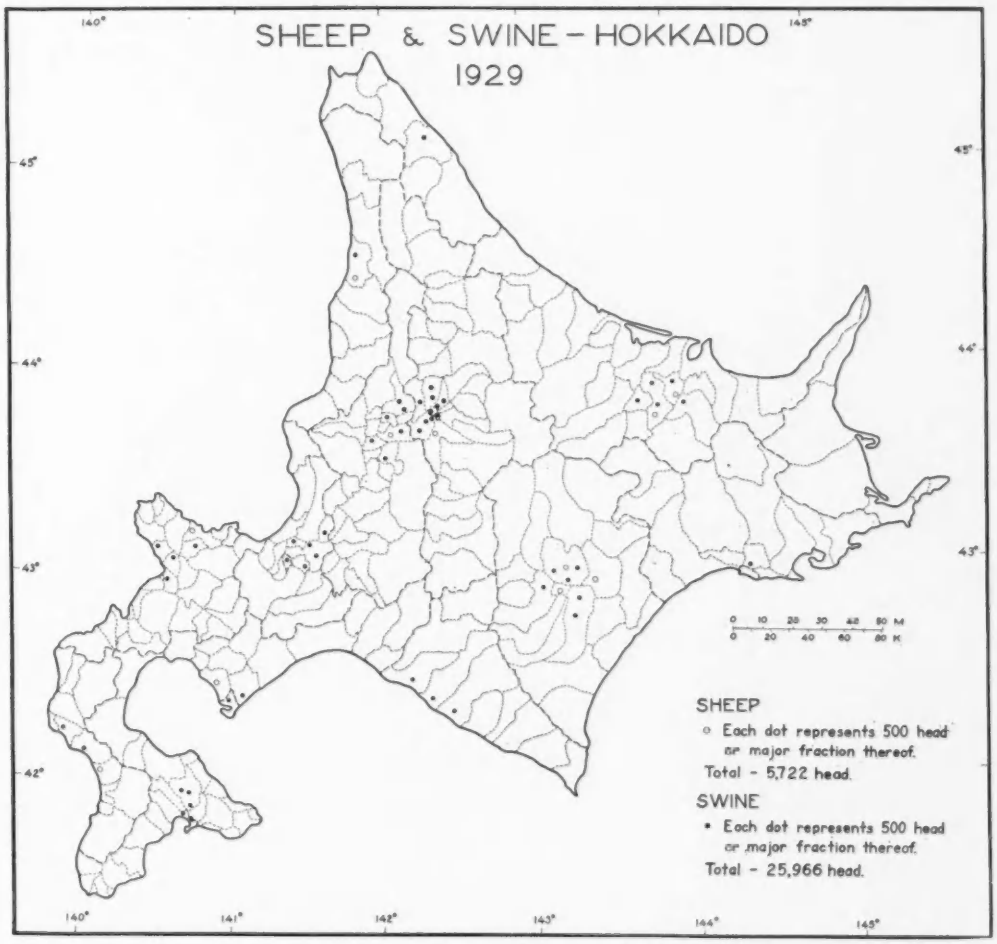


FIGURE 13.—Sheep and swine in Hokkaido—1929.

breeds with considerable success. In 1889, 99.6 per cent of all horses in Hokkaido were of pure Japanese types; at the present time it is almost impossible to find a horse without some admixture of the blood of an imported breed.

The breeding of cattle has also been encouraged by the Government and considerable success has attended the efforts to introduce stock of better milk-producing quality. At the present time, the Holstein is the favorite breed with the farmers. The present production of milk is carried on under such conditions that all milk is served warm, even on the Experimental Farms. Japanese agriculture is of such a type that it will be difficult to remedy this condition. The milk which is sold locally is generally poor in quality and open to serious suspicion on the grounds of cleanness. In addition to the market milk, condensed milk, butter and cheese are produced and sold in the south as well as locally.

Swine are relatively few in number as yet but the number should increase. Pork is in common use and "ham and eggs" can be secured anywhere in Hokkaido. There are only a few sheep in the island and the number of goats is still smaller. The poultry and rabbit industry enables the farmer to add to his income and supplies eggs and meat for local consumption.

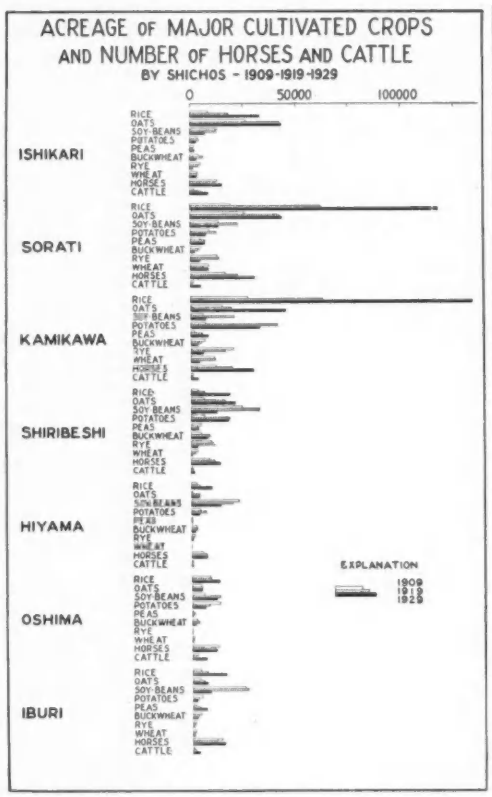


FIGURE 14.—Acreage of major cultivated crops and number of horses and cattle by shichos—1909, 1919, 1929.

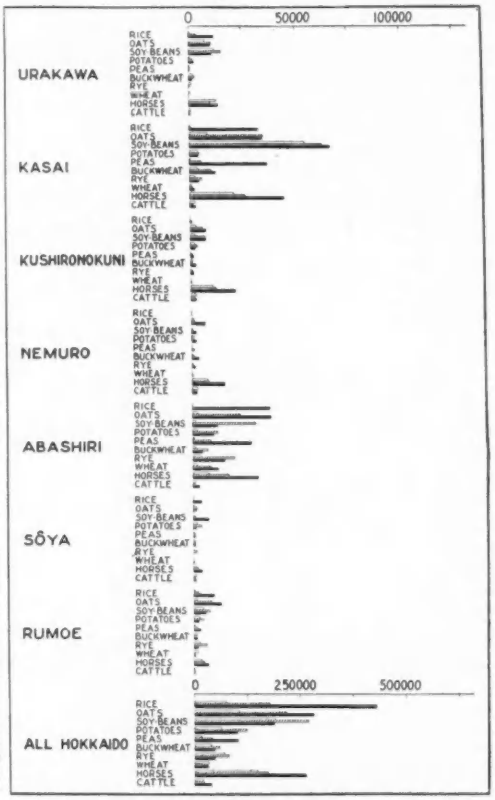


FIGURE 14 (*Continued*).—Acreage of major cultivated crops and number of horses and cattle by shichos—1909, 1919, 1929.

THE FUTURE OF AGRICULTURE IN HOKKAIDO

No great expansion of the agricultural area is to be expected; all of the really desirable land is already in use. The up-

land areas which can be brought into production are of small size, attenuated shape, poorly located with reference to markets and generally handicapped as well by adverse climatic conditions. The lowland areas are also handicapped by the same conditions except for some salt marshes and a larger number of small, poorly drained depressions in the larger plains. Despite the expense of fitting these last areas for use, they will probably be brought into production as the pressure of population increases. The present agricultural population is approximately 2,000,000; this will probably eventually increase to a maximum of 3,000,000.

No startling changes may be expected in the crop system. Rice production will dominate the lowlands in the future as in the past and rice may be expected to continue to hold its present position as the most important cereal crop of Hokkaido by any measure of its importance which may be applied. The only condition which would produce an alteration in this respect would be a great change in the diet of Japanese and there is no good reason for expecting such a change to occur. A deliberate attempt to encourage the substitution of oatmeal, in an important rice-producing area such as Hokkaido, has met with such small success that it is difficult to vision any future change in diet which will displace rice from its present position in the agricultural economy. On the uplands, the present diversified crop system will continue, with oats as the principal cereal crop. The animal industries will undoubtedly increase in both actual and relative importance, especially with improvement in the breeds of farm animals which should increase profits from animal husbandry and so lead to expansion.

Farm practices are probably due for considerable modification in the direction of improvement. Machinery will come into more extensive use and yields per acre of land under production will undoubtedly rise as the teachings of the Agricultural Experiment Stations and the examples of the Model Farms have their effect. That this change should proceed rapidly is highly desirable as a means of providing for the continually increasing population, increasing by both immigration and by the excess of births over deaths, in an area with an inelastic and relatively small amount of arable land. If expected changes should occur, there should be no difficulty in providing for the adequate support of 3,000,000 people by agriculture, the expectation of the Hokkaido Government.

Any careful study of present-day agricultural Hokkaido leads to the inevitable conclusion that no radical changes are in store for the future and that the next few decades will witness only a systematic and orderly evolution along the lines of greater productivity per acre and the addition of a relatively small amount of distinctly sub-marginal land to production on a subsistence basis or to supplement income derived from other sources. This is recognized by the Hokkaido Government and the directed and integrated planning which is in progress will undoubtedly be productive of results which should be of considerable interest.

SPRING AND WINTER WHEAT ON THE COLUMBIA PLATEAU

Victor Roterus

AN INVESTIGATION of the allocation of land to spring and winter wheat in the Columbia Plateau illustrates a common fallacy of broad regional studies. In such studies the facts of locality, of subtle differences within a region, are often obscured by generalized treatment. Hence on somewhat closer examination a speciously homogeneous region is found to have apparently contradictory adjustments to the general scheme of environmental elements.

The wheat area of the Columbia Plateau is a case in point. At first observation the region is, environmentally, fairly homogeneous. Its mean elevation is approximately 2,000 feet (Figure 1). Its soils are prevailingly silt loams and overlie a ubiquitous basaltic bed rock. Its precipitation (Figure 2) though increasing perceptibly from west to east is nearly everywhere marginal in quantity and falls mostly in the winter season. The vegetation reflects the semi-aridity and aridity of the region by ranging from sage brush in the drier phases of the climate to bunch grass in the wetter phases in the east. That the outstanding adjustment made by man to this environmental complex is dry farming with wheat is not surprising. Indeed, so heavily dependent is the livelihood of the entire region upon this one crop that the yield and price of wheat for any given year becomes the vital regional index of prosperity. Yet that this region is given over both to spring and winter wheat is a seeming contradiction to the general homogeneity of the environmental scheme.

Seemingly, deducing from the general facts of the region, there exists no close relationship between the two seasonal wheats and the environment; or if there does, this relationship is ignored by the farmers of the region; or the general facts of the region are an inadequate basis for the interpretation of this apparently contradictory adjustment. The last hypothesis, in the particular case in point, proves upon a close scrutiny of the intra-regional facts to be the true one.

Winter Wheat Dominant

The problem is made cartographically clear in Figure 3. This map is for 1929—in no wise an unique year from the point of view of this article. It shows the percentage of total wheat acreage given over to the winter varieties in the counties of the Columbia Plateau having at least 20,000 acres in wheat. The percentage, it will be noted, varies with fair uniformity. The counties fringing the state line between Washington and Oregon and generally south of the Columbia-Snake have upward of 90 per cent of the total wheat acreage in winter wheat. A second area where winter wheat dominates by occupying at least 60 per cent of the total wheat acreage lies mostly east but also north of the major area of domination. In the northwest part of the Columbia Plateau Wheat Region spring wheat greatly overshadows winter wheat, although in the extreme northwestern sector ("Waterville Plateau") winter wheat almost attains parity with the spring variety. Generally, however, the map reveals that the Columbia Plateau is quite notably a winter wheat region.

The preponderance of winter wheat in the region is due to a number of conditions. A major factor is that the winter varieties are better suited to the seasonal rhythm of rainfall and temperature than the spring varieties. The precipitation occurs chiefly during the winter months. At Pullman, Wash., in the heart of the largest wheat producing county of the plateau, 50 per cent of the precipitation occurs during the four winter months from November to February inclusive (Figure 4). That percentage holds true for the plateau generally with no departures of more than 10 per cent either above or below. The July and August months at all weather stations in the area average a fraction of an inch rainfall for each month; at Pullman only 5 per cent of the total annual precipitation coming during those two months. Planted in the fall the wheat receives a long formative period of cool, moist weather both in the fall and spring, and gradually comes to maturity in the warm bright dry summer when harvest conditions approach the ideal.

Winter wheat has been found to outyield spring wheat in experiments conducted at state agricultural stations in Washington and Oregon. Probably this is due to the longer formative period made possible by fall planting and to the diminished chance, through earlier maturation, of a shrivelled and pinched grain. Spring wheat, maturing later, is often "burned" ruinously by hot dry winds during the blossoming and heading period. A three-year experiment at Moro, Oregon, resulted in an average yield of 22.6 bushels of winter wheat

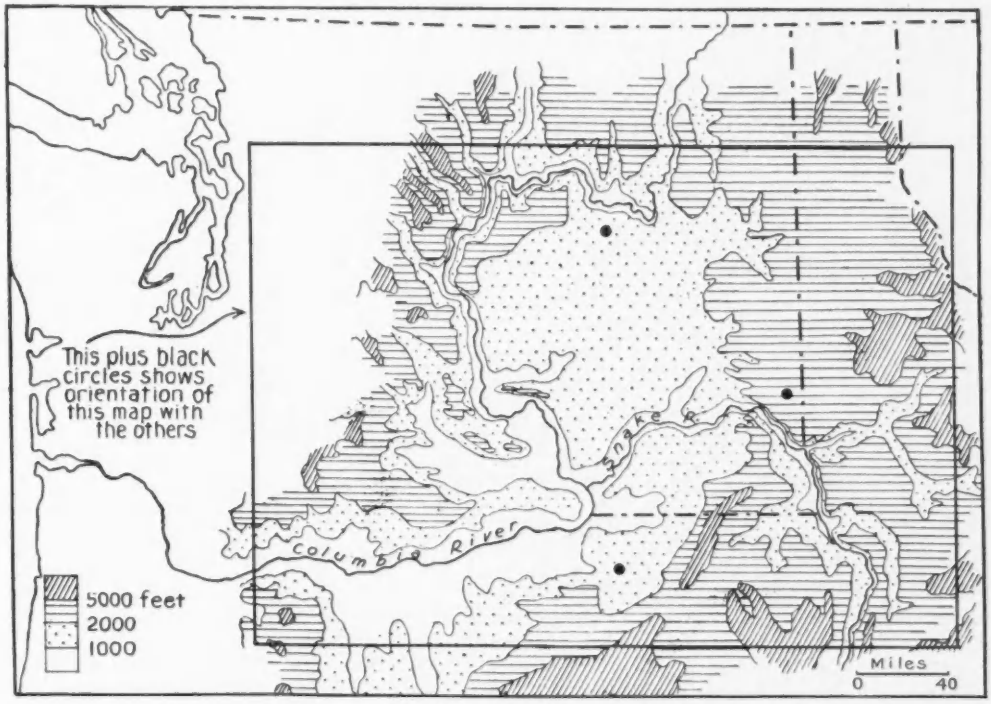


FIGURE 1.—Generalized relief map of the Columbia Plateau Wheat Region which occupies parts of Washington, Oregon, and Idaho. The inner border and the three black circles (Wilbur in the north, Pullman in the east, Pendleton in the south) are orientation aids for the other maps. The "Waterville Plateau" is the area over 2000 feet just west of Wilbur; it is part of the "Big Bend" section, so-called because it is inclosed by the bend of the Columbia River.

contrasted with an average 15.1 bushels yield of spring wheat, a difference of 7.5 bushels. These experiments confirm the general impression existent among the farmers of the area; and favor cropping to the winter varieties.

A possible added incentive to plant with the winter varieties is that a better distribution of labor is effected. This is due to the prevalent system of summer fallowing the land every other year in order to accumulate nitrates in the soil, to store precipitation for use the following year and to check weed-growth while preparing a seed bed for a more certain germination of fall-sown wheat. Summer fallow operations usually begin early in April with disking and continue through the latter part of July with harrowing, plowing, and weeding. The harvesting operations of binding, shocking, and threshing usually occupy the entire month of August, although at times they may begin the latter part of July or extend into September.

Planting of the winter wheat normally begins in early September and sometimes is extended into October. The practice of cropping with winter wheat in the summer fallow system thus enables the farmer to distribute his time from April into October with a fair degree of evenness in that the summer fallow, the harvesting, and the sowing operations fall quite distinctly into definite and successive periods. Spring planting, occurring as it does in the latter part of April and early May, tends to wreck the even tenor of labor distribution by conflicting with the normal summer fallow operations of disking and harrowing. The need for getting the seed into the ground as soon as conditions permit means that certain summer fallow duties

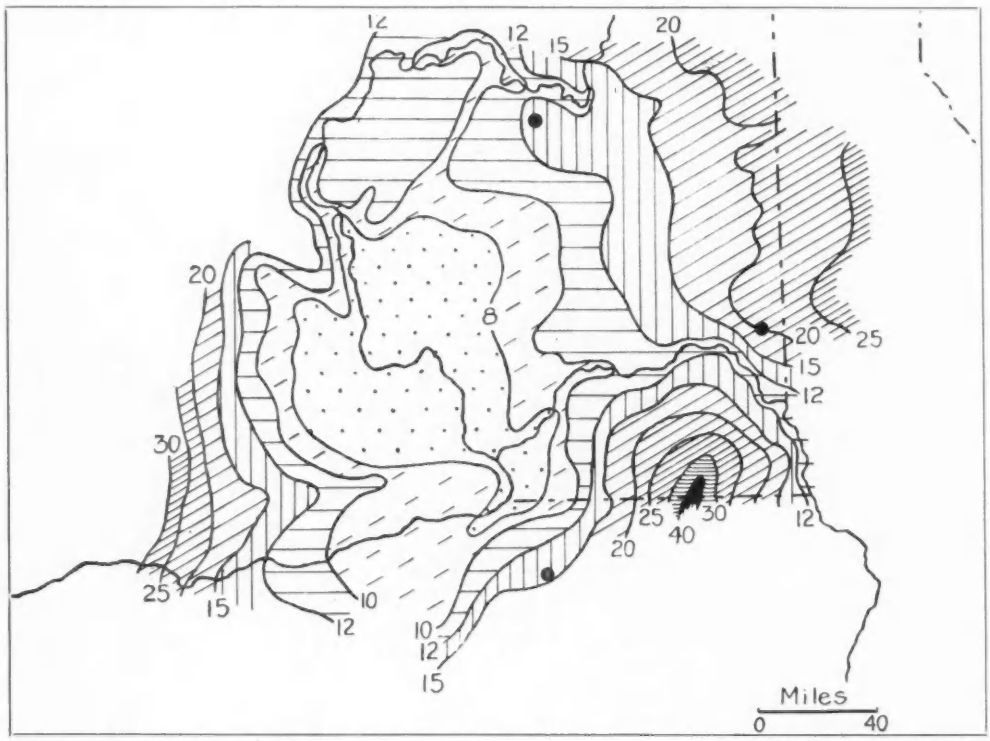


FIGURE 2.—Generalized annual rainfall map (in inches) based on available data for the Columbia Plateau Wheat Region. The figures on the isohyets indicate inches.

must be either neglected or deferred to a less propitious time unless additional labor is employed. Although the harvest of spring wheat is roughly ten to fifteen days later than that for winter wheat, this does not disrupt the labor distribution unless the crop yield is disappointing and the farmer wishes to recoup some of his losses by planting in the fall varieties.

The above reasons—adjusting to the seasonal rhythm of precipitation and temperature to make for a more certain crop, greater yield and better labor distribution—influence the cropping of the major portion of the Columbia Plateau Wheat Region to winter wheat, but these reasons lose potency and application in the northwest part ("Big Bend" section) of the area.

SPRING WHEAT DOMINANT

Although the general outlines of the climate of the section markedly dominated by the spring varieties of wheat are not dissimilar to those prevalent elsewhere on the plateau, the particular features do show a slight, but telling, dissimilarity. In the "Big Bend" a decrease both in precipitation, more precisely snowfall, and winter temperature is a governing factor in the selection of the seasonal variety of wheat to be planted (Figure 4). As contrasted with the eastern part of the wheat area where the annual precipitation is more than 15 inches, here the precipitation of land in wheat ranges from 8 to 15 inches. This means a decided deficiency and irregularity in the snow covering demanded by winter wheat to protect, during the cold months, the green blades which sprouted several inches in the fall.

Another important factor discouraging cropping to winter wheat is the general lack of September and October rainfall in the Big Bend section, strikingly revealed by Figure 4. A fair rain is necessary during these months to insure germination of fall-sown wheat. Whenever the fall precipitation in the Big Bend is abnormally high the percentage of land in winter wheat is apt to increase. In 1928 when the rainfall was double the usual amount, over 50 per cent of Big Bend wheat acreage was

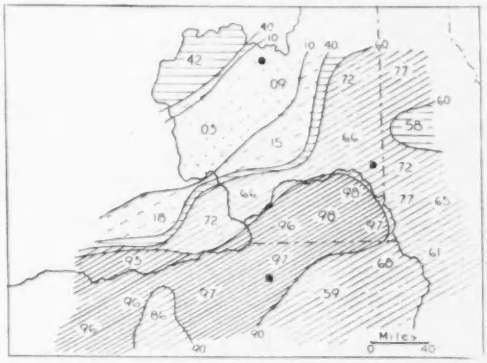


FIGURE 3.—Isopleth map showing percentage of total 1929 wheat acreage in winter varieties. Only counties with more than 20,000 acres in wheat were considered.

sown to winter varieties. The eastern part of the wheat area as typified by Pullman's climate (Figure 4) is much more fortunate in the amount and regularity of its fall precipitation.

Much of the section of greatest dominance in winter wheat has, however, very little more rainfall than the Big Bend section, so that the lack of an adequate protective snow covering is hardly the only considered factor in selecting the time of sowing. The deficiency and uncertainty of the snowfall is inevitably allied to the factor of temperature. The difference in winter temperature affects the vast disparity in choice of seasonal varieties between the area where winter wheat is over 90 per cent and where it is less than 20 per cent present. Ephrata, Odessa, and Wilbur, three scattered stations in the latter belt, have January mean temperatures of 24.8, 25.4, and 21.9 degrees respectively. In the section strikingly in winter wheat, the mean

January temperatures of the randomly selected stations of Umatilla, Pendleton, and Walla Walla are 33.6, 33 and 32.7 degrees (Figure 4). January in this section is thus about nine degrees milder on the average than in the Big Bend section; and the need of a protective snow covering is not nearly so exigent. The wheat is apt particularly to be injured by sudden drops of temperature to zero levels, especially if such a drop follows mild humid weather.

The Big Bend is more subject to such caprices of weather than the section about Pendleton. This is commonly ascribed to the fact that the latter area is more exposed to the ameliorating influences of the Pacific due to the uninterrupted eastward passage of winds through the Columbia gorge (Figure 1). The Big Bend has no such avenue of approach, the Cascades constituting a formidable barrier to marine influence. The climatic graph shows higher summer temperatures in the Pendleton region enhancing the danger of spring wheat to shrivel before it has matured. Many parts of the section more than 90 per cent dominant in winter wheat experience both adequate snowfall and relatively mild winter temperatures which accounts for the decided proclivity of the farmers for winter varieties.

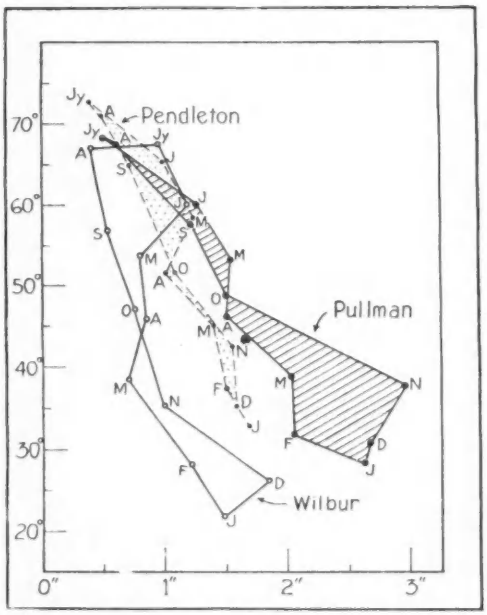


FIGURE 4.—Graph showing climates of three strategically located stations of the Columbia Plateau Wheat Region. Wilbur is typical of the "Big Bend" or spring wheat section, Pullman of the section 60 to 90 per cent in winter wheat, and Pendleton of the section more than 90 per cent in winter wheat. The locations of these stations are shown on the maps. Wilbur has an average annual precipitation of 12.42 inches, Pullman, 20.73, Pendleton, 14.12.

In the extreme northwest corner of the region on the "Waterville Plateau" (Figure 1) there is about as much winter wheat as spring wheat due mainly to the fact that precipitation is greater here than in the rest of the Big Bend. A higher local elevation gives this sector several inches more precipitation, including almost three times the snowfall, than that received by adjacent wheat lands. The amount of fall rain thus has a profound influence on whether the land is to be cropped in winter or spring wheat.

SPRING WHEAT ANOMALY

A final question suggested by the map is that in the winter wheat areas why should spring wheat be grown at all? Generally the preference of the farmer, for reasons already discussed, is for the winter varieties. This choice is tempered by fall weather, by failure of the winter wheat, and local variations in early frosts. If in September and October the rainfall is not sufficient to permit extensive seeding or to insure germination, much of the land is left idle until April and May when it is planted in the spring varieties as a second best measure.

Oftentimes when the snow blanket melts away and the land is subsequently subjected to sudden severe freezing temperatures much of the winter crop is ruined. These spots are replanted in spring; and if the damage to winter

wheat has been unusually extensive, as in 1925, the acreage in spring wheat may exceed that in winter wheat for that particular year. Some localities, spotty in distribution and having a higher altitude than the immediate surrounding area, are subject to fall killing frosts, and hence plant the spring varieties. This, particularly true in the eastern margin of the wheat region, has the effect of lowering the winter wheat percentage for the general area.

The discussion probably does not exhaust the series of factors involved in the allocation of area to spring and winter wheat within the Columbia Plateau; but it should serve to illustrate that an appreciation of the intricacies of the intra-regional pattern demands more particularized touches of the interpretative brush than the generalized sweeps resulting from an application of broad regional colors.

GEOGRAPHIC ASPECTS OF COAL CARGOES FROM TOLEDO

Walter G. Lezius

A STUDY of commerce in coal on the Great Lakes reveals the interesting fact that Toledo is not only the largest coal shipping port, but in certain years has shipped 42 per cent of the combined coal tonnages of all Lake Erie ports. Numerous trainloads of coal from the southeast may be seen rolling into Toledo, where most of the coal is dumped into the holds of lake freighters destined for upper lake ports. The magnitude of this business is often taken for granted without inquiring into the real reasons for it. The questions arise, however, as to why Toledo enjoys the foremost position in this instance, and whether this business will decline or continue to be enhanced. Disturbances of the equilibrium of economic forces sometimes occur with great suddenness. These, together with dynamic changes in man's adjustment to the natural environment, govern the lake coal business of Toledo.

The universal importance of coal is aptly stated in the ensuing quotation. "Coal is the most important mineral product both commercially and industrially. It is the greatest source of power for manufacturing, mining, and transportation; it is a major raw material in the manufacture of iron and steel, gas, and dyes; and it is the principal source of fuel for most of the industrial nations of the earth. The production of coal constitutes the largest mining industry of the world and, in America alone, employs more than a half million men." [1] Toledo, in its own interest, should covet future lake coal cargoes.

Port of Toledo and Coal Shipments

Toledo has a contributory rather than a distributary hinterland. During the decade 1921–1930 the domestic shipments from Toledo terminals were more than five times in excess of the domestic receipts. Coal constituted practically all (99.7 per cent) of the domestic shipments. Exports of coal to Ontario, Canada, comprised 97.7 per cent of the total exports or an average annual movement slightly more than 1,500,000 tons during 1921–1930. The average annual movement of coal from Toledo for this ten-year period was in excess of 11,000,000 tons. Shipments augmented rapidly from 7,354,588 tons in 1921 to 14,681,407 tons in 1927. Coal cargoes totaled 15,483,410 tons in 1930 regardless of the primary stage of business inactivity. To be sure, 1931 and 1932 were subnormal years due to economic (and not geographic) conditions. This port is witnessing a resumption of coal business during the latter part of 1933, however, as the result of a long delayed demand together with the contemplated and actual inflation of prices and operating costs incurred by the NRA. Current statistics indicate that Todelo's coal business at the present rate of increase may become commensurate with the 1930 tonnage figure surprisingly soon. Coal shipments in August and September 1933 amounted to approximately 2,350,000 and 2,150,000 tons respectively. Inasmuch as coal affords the major commercial ac-

[1] Reprinted by permission from "College Geography" by Case and Bergsmark, published by John Wiley and Sons, Inc.

tivity of this port, and for the reason that coal movements have been rapidly reviving, it appears that the Port of Toledo has an optimistic immediate future.

RICH PRODUCING HINTERLAND

One of the fundamental requirements for an ideal port is that of a sizable producing hinterland. Toledo has this. The Middle Appalachian Coal Field primarily comprised of southern West Virginia and eastern Kentucky affords low-cost but high-quality coals which, together with coals from western Virginia, southeastern Ohio, and occasional shipments from southwestern Pennsylvania, pass over the docks at Toledo.

The known coal reserve is not only exceedingly great, but has many grades

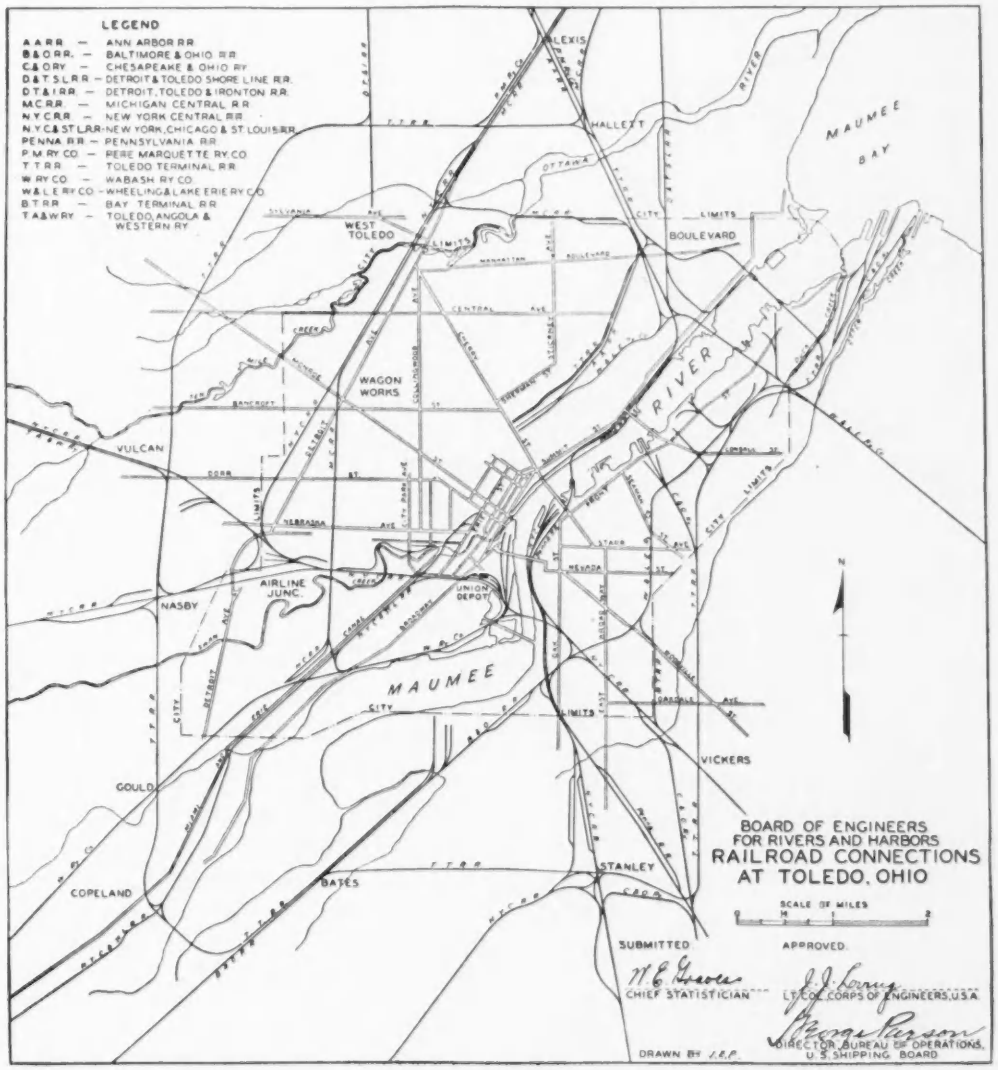

LEGEND
A A R R — ANN ARBOR R R
B & O R R. — BALTIMORE & OHIO R R
C & O RY — CHESAPEAKE & OHIO RY
D & T S L R R — DETROIT & TOLEDO SHORE LINE R R
D T & I R R — DETROIT, TOLEDO & IRONTON R R
M C R R — MICHIGAN CENTRAL R R
N Y C R R — NEW YORK CENTRAL R R
N Y C & ST L R R — NEW YORK, CHICAGO & ST LOUIS R R
PENNA R R — PENNSYLVANIA R R
P M RY CO — PERE MARQUETTE RY CO
T T R R — TOLEDO TERMINAL R R
W RY CO — WABASH RY CO
W & L E RY CO — WHEELING & LAKE ERIE RY CO
B T R R — BAY TERMINAL R R
T A & W RY — TOLEDO, ANGOLA & WESTERN RY
ALEXIS
HALLETT
MAUMEE BAY
OTTAWA
WEST TOLEDO
LIMITS
BOULEVARD
WAGON WORKS
VULCAN
AIRLINE JUNC.
NASBY
UNION DEPOT
MAUMEE
VICKERS
GOULD
COPELAND
BATES
STANLEY
RIVER
N
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
RAILROAD CONNECTIONS AT TOLEDO, OHIO
SCALE OF MILES
SUBMITTED
CHIEF STATISTICIAN
APPROVED
LT. COL. CORPS OF ENGINEERS, U.S.A.
DIRECTOR, BUREAU OF OPERATIONS, U. S. SHIPPING BOARD
DRAWN BY J.E.P.

FIGURE 1.—Toledo, by virtue of its strategic location, is one of America's largest rail centers. This trade center, being dependent to an exceedingly great extent upon commerce, has its business life nourished by the numerous railroad arteries. Some of the most important coal-carrying railroads have spurs connecting with four coal docks which, it may be observed, are situated along the right bank of Maumee River.

of coal that may be used for diversified purposes. For instance, coals from the Pocahontas, Beckley, and Sewell seams are used for domestic purposes in that they are almost smokeless. Of even greater importance is the possibility of utilizing coal from numerous collieries of the above-mentioned region for metallurgical purposes, thus creating a vast demand for these low volatile coals to be used extensively in by-product coke ovens. Thus iron and steel producers at Chicago, Gary, Indiana Harbor, Milwaukee, Duluth, and Detroit find it necessary to receive millions of tons of this coal annually—via Toledo. Detroit and River Rouge receive coal primarily for use in the automobile industry. Green Bay, Wisconsin, and Sault Ste. Marie, Ontario, receive a considerable amount of coal (nearly 675,000 and 700,000 tons respectively in 1930). Coal also moves through Toledo to be used for railroad locomotives (Figure 1) and for bunkering.

The magnetic force of the huge high-quality coal reserves in the Middle Appalachian Region has been causing coal production to gravitate to the producing area immediately south of Charleston, West Virginia (Figure 2). Coal in the vicinity of the Pittsburgh District is still famous because of its high quality for a variety of purposes and its quantity production. Still, the Pittsburgh District, which is the largest producer of iron and steel in the world, uses most of the coal produced in that region. West Virginia, however, producing as much coal as Pennsylvania since 1926, is notably lacking in manufactures. West Virginia consumes only several per cent of its annual coal production. Furthermore, the cost of mining coal in the Middle Appalachian Field is lower (even though the point of maximum cheapness has been passed) than that of any other coal region in the United States, due to the deeply dissected condition of the plateau in this section making drift mining of the thick horizontal strata a relatively cheap and easy matter.

THE ACCESSIBILITY FACTOR

Topographical conditions of the intricately-dissected Appalachian Plateaus deny rail carriers the privilege of radiating in direct routes from the coal fields to places where the coal is destined to be consumed or transferred to lake carriers. In all cases that might be cited, coal-carrying railroads in the Appalachian Plateaus follow routes of least resistance. Rather are the rails laid adjacent to the rivers in order to profit from comparatively low, level land. For example, coal is tippled from the mine portals directly into rail cars located along the Kanawha and Big Sandy River Valleys, whereupon the cars begin their journey down these valleys. It is to be noted, incidentally, that Kanawha River, which has incised itself in the richest section of the Middle Appalachian Coal Field, flows to the northwest in the general direction of Toledo thereby influencing rail carriers to follow this route. Upon their arrival at the Ohio Valley, the coal cars descend its course for a short distance to the Scioto Valley. Here they again follow a natural trade route to the comparatively low Scioto-Sandusky col proceeding therefrom across the Lake Plains to Toledo. Thus the Port of Toledo has exceptionally easy access to its coal-producing hinterland. This and other interrelated factors have been of utmost importance in influencing the growth of coal trade from an early date.

RAIL RATES ON COAL TO LAKE ERIE PORTS

Freight rates per ton on lake coal from various originating districts to the Lake

Erie ports, i.e., Toledo, Sandusky, Huron, Lorain, Cleveland, Fairport, Ashtabula, Conneaut, Erie, and Buffalo are as follows:

Hocking, Cambridge	$1.43
Youghiogheny, Pittsburgh, Moundsville	1.46
Connellsville, Klondike	1.54
Fairmont	1.66
Kanawha, Thacker, Logan	1.81
Cumberland, Piedmont, Gauley	1.83
Pocahontas, New River, Stonega	1.96

It will be noted that there is a considerable rate differential in favor of the first-named mine groups due to shorter mileage to Lake Erie. Still, most of the lake coal originates in the latter mine groups (especially those of southern West Virginia and eastern Kentucky having $1.81 and $1.96 rates) despite the higher rail rates incurred by a longer mileage to Lake Erie. This paradox is really rectified to a very large extent by the lack of nearby markets, generally high quality coal, and lower mining costs of the Middle Appalachian Field.

In addition, the above rates are not published from all origin districts to all lake ports. For instance, from the groups taking $1.81 and $1.96 rates (the largest producers of lake coal), the rates are published only to Toledo and Sandusky thereby giving these shipping points a marked advantage over other Lake Erie ports.

Favorable Harbor and Port Conditions

Toledo has a remarkable river and bay harbor formed by the Maumee which is the largest river emptying into the Great Lakes. The harbor has a mud bottom allowing for less expensive dredging and safer navigation than a rock bottom harbor such as that at Sandusky. A low shore line of unconsolidated materials with sufficient room thereupon for expansion of commercial and industrial sites is another encouraging harbor condition. The easily negotiable entrance channel of Maumee Bay and lower reaches of the river has a controlling depth of about 21 feet with turning basins provided for long lake freighters. The navigation season normally extends from April 1 to December 10. Thus, freighters are induced to moor at Toledo due to its comparatively short closed season.

There are five coal terminals located along the river front which are equipped with electric or steam operated car dumpers. No other lake port has in excess of two coal-handling machines. The newest coal-handling equipment of any Great Lakes port is to be found at Toledo, since the construction of the $8,000,000 Chesapeake and Ohio Rail-

FIGURE 2.—The great bulk of lake coal originates in the coal fields shown here. The general routes followed by the largest coal-carrying railroads are also indicated. A physiographic diagram of this region clearly illustrates why the transportation patterns are irregular in the Appalachian Plateau. The topography of southern West Virginia and eastern Kentucky influences the rail lines to tend northwest to the Scioto Valley before the tracks assume a more direct path to the southern shore of Lake Erie. Rails originating in the Hocking Valley District also tend to the northwest to Columbus in the Scioto Valley before taking the more direct route to the north. In that the rails are of necessity laid as far west as the Scioto Valley, there are only two logical terminals from which to ship the coal—Toledo and Sandusky. These two ports are located on the more direct route which rails are enabled to follow as a result of the gently undulating and level land of northern Ohio.

way Coal Dock (Figure 3) in 1930. This modernly equipped quayage facility is several miles nearer Lake Erie than the old Hocking Valley Railway Docks. There is a slip on either side of this new coal-dumping pier having a depth of twenty-three feet and a combined mooring capacity for twenty of the largest allowances to fast unloading docks for guaranteed dispatch. The charge for transferring coal from cars to vessel is now uniform at all lake ports, viz.: eight cents per ton.

The New York Central Lines Coal Dock also deserves special mention in that the operating capacity of its coal-

FIGURE 3.—A view of the Chesapeake and Ohio Railway coal docks (east side of mouth of Maumee River at Presque Isle) showing two all-electric car dumpers having a combined operating capacity of 12,000 tons per hour. This dock is constructed of steel and timber piling and has a concrete wall with earth fill. Additional coal-handling equipment is being provided at Presque Isle which is unmistakably a result of its having a most accessible location at the river embayment for long lake freighters.

lake vessels. The mechanical handling facilities at these docks consist of two electric Brownhoist car dumpers with a lifting capacity of one car of 120 tons and a combined operating capacity of 100 cars per hour. Consequently, the new 100-ton flat bottom gondolas are handled with dispatch. This feature is an incentive to the steamships to load at Toledo in that they are at all times desirous of getting the coal loaded with a minimum amount of delay. Although it is not common practice to differentiate in transfer rates between docks as to their speed in handling cargoes, there have been rare cases in the past of giving handling equipment is comparable with the above. Still, its location several miles from the debouchment of the Maumee is not nearly so favorable as the new Presque Isle docks because of the additional river navigation thereby necessitated. Varying depths of the river caused by the Prevailing Southwesterlies and silting sometimes make navigation uncertain. Furthermore, the Presque Isle docks save about six miles of river navigation in addition to eliminating delays and hazards incurred when lake freighters have to pass several draw bridges. The Baltimore and Ohio Railroad Coal Dock has a steam-operated car

dumper producing an operating capacity of 40 cars per hour. The lead-in and return tracks together with car space is correspondingly less than in the former two examples. A belt-line railroad extends around the entire city affording proper coordination of the rail lines entering the port area with the water front.

The port facilities are excellent in that they are adequate for the present volume of business and expedite coal transports from rail to steamship contract lines and also private bulk freighters such as those of General Motorship Corporation and the Henry Ford Steamship Company. Transfers of coal from rail to water carrier at Toledo have been sufficiently large to warrant the tremendous capital investment in modern, economical quayage facilities.

COAL SHIPMENTS BY PORTS

The accompanying tabulation clearly indicates Toledo's paramount position in coal tonnage movements. The obvious tendency for the majority of lake coal to move via the ports at Toledo and Sandusky attests the significance of their favorable geographical position at the western end of the southern shore of Lake Erie. It is also interesting to note the relative rank in coal movements of four most prominent rail carriers serving Toledo. The Chesapeake and Ohio Railway facilities are of utmost importance and partially explain Toledo's dominance in lake coal cargoes.

	1930	*1931*	*1932*
Toledo	15,483,410	12,603,750	10,192,118
C. & O. Ry.	7,973,446	8,171,794	7,230,866
Ohio Central Ry.	3,164,965	2,107,683	1,511,884
Big Four Ry.	2,403,629	1,230,569	646,394
B. & O. Ry.	1,941,370	1,093,704	802,974
Sandusky	7,702,258	6,186,595	4,404,808
Ashtabula	3,460,103	3,252,569	3,078,189
Erie	2,172,299	2,048,089	1,438,661
Conneaut	2,025,533	1,480,829	807,717
Lorain	1,982,851	1,415,383	945,604
Cleveland	1,865,415	1,553,465	1,557,065
Huron	896,766	804,990	556,546
Fairport	810,709	459,171	938,986
Buffalo	440,579	610,450	643,625

COAL RATES TO UPPER LAKES

Contract rates on coal have been continued at the level established in 1931 as follows:

	Per Net Ton
To principal ports on Lake Superior	$0.35
To principal docks at Milwaukee	.45
To principal docks at South Chicago and Indiana Harbor	.45
To Georgian Bay	.35

The differential to side ports on Lake Michigan, such as Manitowoc, Escanaba, Green Bay, and Sheboygan, is 40 cents per net ton.

DESTINATION OF COAL SHIPMENTS

Figure 4 illustrates the major locations to which lake coal from Toledo is delivered; 15,483,410 tons of coal moved over the docks at Toledo in 1930, of which ports on Lake Michigan received about 35 per cent, ports on Lake Superior 28 per cent, Detroit and St. Clair River ports 20 per cent, and ports on St. Marys River 5 per cent. Most of the remaining percentage consisted of export trade to Ontario, Canada.

CONCLUSION AND INFERENCE

In retrospect it is well to summarize the geographic and related influences which have tended to make the Port of Toledo an outstanding coal conveyor of the world. Toledo's distinctive rank is consequent upon:

(1) Momentum of an early start as evidenced by the establishment of the Toledo and Ohio Central Dock in 1869 and the Hocking Valley Railway Dock in 1877.

(2) Copiousness of Toledo's coal-producing hinterland, i.e., southern West Virginia and eastern Kentucky produce the bulk of the coal that is forwarded to lake for transshipment.

(3) Accessibility to the producing hinterland as a result of favorable

topographical conditions and existence of well-developd transportation facilities.

(4) Four of the largest coal-carrying railroads connect some of the most important collieries directly with the Port of Toledo, thereby eliminating delays encountered by interchange between railroads.

(5) The favorable rail rates published from the all-important districts of southern West Virginia and eastern Kentucky are confined to Toledo and Sandusky which give these ports a distinct advantage. The concept with regard to competition between these two ports is that other conditions remaining the same, Toledo and Sandusky, by virtue of the parity of freight rates, would be enabled theoretically to participate in the same amount of coal business. But other conditions are not alike. Toledo enjoys several advantages over Sandusky. One of the most pronounced advantages is that of geographical position which has made Toledo the greatest coal-carrying rail center of the southern shore of Lake Erie. Location, together with more adequate and modern coal-dumping equipment, have been of importance with reference to the saving in time for shipments of coal to upper lake ports. Toledo's preeminence over Sandusky is also incurred by other advantages such as more favorable harbor conditions.

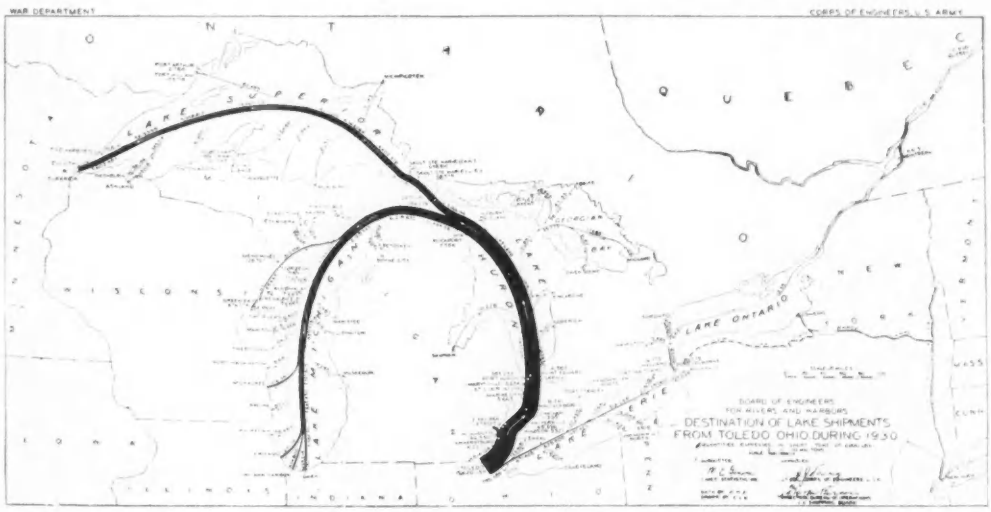


FIGURE 4.—Personal reconnaissance at Toledo reveals that its lake commerce is predominantly in coal cargoes, practically all of which are transferred from rail to water carriers and conveyed to ports of the upper lakes. The vast coal-consuming hinterland, as illustrated by the map, has grown to premier rank in the commercial world and represents a further reason for Toledo's avarice toward additional coal cargoes.

(6) Favorable harbor conditions furnished by Maumee River.

(7) Adequate modern, and conveniently-located mechanical facilities for conducting the coal trade.

(8) Veritably cheap water transportation afforded by the Great Lakes and consequential low cost of transporting coal to numerous consuming centers in the upper lake region.

(9) Toledo's location upon the greatest inland waterway trade route of

the world—the unbalanced freight problem created by tremendous iron ore movements from the Lake Superior region to lower lake ports is largely nullified at Toledo by return cargoes of coal. Lake freighters transport coal to upper lake ports at a reduced rate (generally one-third less than that for iron ore) in order to attract its movement, thereby partially avoiding otherwise uneconomical freight movements.

(10) Close proximity to markets—its favorable geographical position at the western extremity of Lake Erie with reference to commerce in coal bound for upper lake ports makes it the logical coal shipper. Toledo is a coal shipping center nearest to the largest consuming area of lake cargo coal. Thus no other Lake Erie port has as short a vessel haul.

The known coal reserves of the Middle Appalachian Field are sufficiently great to insure the port adequate high grade coal at the present rate of shipment for at least several generations. Seasonal fluctuations in the volume of coal business will continue to be experienced, however, due to closed navigation on the Great Lakes during the winter months, occasional strikes in the coal regions, normal seasonal changes in industrial production, etc. Coal cargoes from Toledo will continue to increase with the revival of general business conditions in the direction toward the prosperity period of the business cycle. The progressive expansion in secular trend of commerce and industry from one complete business cycle to another should sponsor a reoccurring increased growth of the port's business during future years.

Additional commerce should be attracted to the Port of Toledo as a result of the present harbor improvement program for which the Federal Government has appropriated $2,900,000. The creation of an aspiring Port Authority with power to progressively administer port problems, thereby obliterating dilatory proceedings, will also insure Toledo a contemporaneous enhancement of coal cargoes.

THE SWEET CORN INDUSTRY OF MAINE

Albert S. Carlson and John Weston

SWEET corn for canning has attained the rank of a specialized commercial crop in several sections of the country. Illinois, Iowa, Minnesota, Indiana, Ohio, Maryland, Maine, New York, and Wisconsin lead in production. Maine's position in the list needs further explanation, inasmuch as the figures showing the farm price of sweet corn place Maine at the head of the list, with the value per ton approximately twice that of any of the other states. In a comparison of the production of the other sweet corn states with that of Maine, they may be divided into three groups: first, Minnesota, Iowa, and Illinois, producing from 2.5 to 4.5 times as much corn as Maine, but only canning .05 to 3 times as much; second, Maryland, Ohio, and Indiana, producing from 2 to 2.3 as much corn as Maine, but canning approximately the same amount; third, New York which produces approximately the same amount of corn, but cans less, and Wisconsin which produces less and cans from one-third to one-half of the Maine total. Thus, although Maine is low on the list as far as total acreage and production are concerned, the quality of the Maine sweet corn, as indicated by a price approximately twice that of the corn from other states, is higher, and a large proportion of the total production of the Maine crop goes into the canneries.

The growing of sweet corn in Maine is one of the most important specialized agricultural interests of the state. In the central and southern portion of the state, sweet corn is a cash crop. In many towns there are more than one "corn shop." The value of the sweet corn raised in Maine in 1928 was $1,319,975. The number of cases canned in 1929 was 1,566,014, with a value of $3,909,031. On the basis of value, this is six times greater than the next two vegetable crops grown for canning, namely, beans and peas. The leading corn-producing counties in Maine are Oxford, Somerset, Kennebec, Androscoggin, and Waldo. These counties are also

FIGURE 1.—A field of Maine Golden Bantam corn ready for the husking. The stalks are five feet high each bearing one good ear for canning.

the leaders in the number of sweet corn canneries.

The concentration in the producing areas within each county is indicated by the map showing the distribution of sweet corn canneries by towns. It displays the distribution of acreage within each county, because the fields of corn are located within an average distance of seven and one-half miles of the canneries, necessary because the time between the picking and the canning of the corn must be brief, the canner can secure a sufficient amount of corn within this area, and close coöperation between the farmers and canners throughout the growing season is necessary for the canning of high quality corn. Within the counties mentioned, the canneries lie mostly in the towns along the Kennebec, Androscoggin, and Saco Rivers.

The importance of climatic factors is demonstrated by the results of experiments carried on by agricultural experts interested in the breeding of improved varieties of sweet corn. "The quality of sweet corn is dependent partly on varietal differences, but primarily on climatic conditions and the length of time from picking to packing. Puncture tests show that Crosby corn grown in Maine maintains its tenderness for several days after it reaches the prime canning condition. Under the average conditions in Maine, sweet corn remains in good canning condition in the field for about five days. The greater length of time the sweet corn remains in proper canning condition and the cool weather at the time of packing are undoubtedly two of the reasons for the superiority of Maine sweet corn."

Also, the packer desires the corn picked when it contains a high percentage of sugar, and yet sufficiently mature to contain enough starch for sufficient body and texture in the canned product. Temperature at the time of picking largely controls the sugar and starch content. In addition to influence on the quality and date of picking, climatic factors produce the chief forms of hazard to both planter and cannery owner. Their risks are always great, and the losses sometimes large. "The growing season to be expected, at best, is dangerously close to the minimum time to grow corn. When to this are added the risks arising from the occurrence of late spring and early fall frosts, together with an uncertain distribution of rainfall during the growing season, it is evident that there must always be a considerable element of uncertainty as to whether, on the one hand, the farmer who plants sweet corn will get enough out of his crop to pay for seed and fertilizer and, on the other hand, the packer will be able to produce the number of cans to fill his contracts."

Mean annual temperature for the

FIGURE 2.—At the height of the season pickers must get into the field early to gather the corn while yet the cool of dawn lies over the fields. Much of the secret of high sugar content lies in the way that the corn is harvested and brought to market.

sweet corn area of Maine is between 43–46° F. The temperature during December, January, February, and March are low enough to keep the ground frozen and to cause snow to fall. This prevents a large amount of soil leaching and alternate freezing and thawing of the ground. The spring and summer

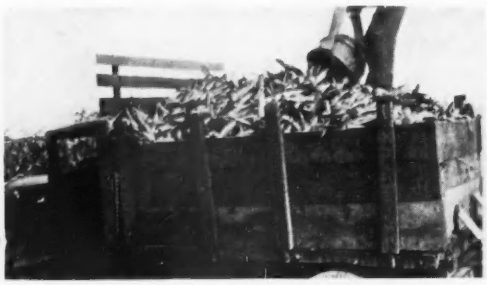


FIGURE 3.—The most common conveyance for taking the corn to the canning factory is the automobile truck, although horses are still used in many places and on many farms.

temperatures rise from 42–43° F. in April, to a maximum in July of 69° F., while August temperatures are 1–4° F. lower. September temperatures are 7–9° F. lower than those of August, resulting in a cool harvest period. The mean of the maximum and minimum temperatures for each month indicate that the temperature range varies from 5 to 10° F. above and below the average for each month during the growing season. The range above and below the mean average temperature is about the same throughout the season.

During the later part of August and in September, the days are warm and often hot, but the nights are cool. The hot days are important in aiding the corn in the field to reach the ripening stage, while the cool nights help to maintain the moisture content of the corn which has been picked and is en route to the factory.

The length of the growing season, as indicated by the data available for Portland and North Bridgton, ranges from four and one-half to five and one-half months and at Fryeburg 105–110 days, i.e., from May 20–June 1 to September 1–15. Definite figures for the rest of the region are not available, but it would seem that the average growing season throughout the region would be from four to five months (120 to 150 days), not long enough to permit planting after the date of the last killing frost in spring and harvesting before the first killing frost in the fall, to avoid the danger of damage to the crop by frost.

To secure a crop, the farmer must make use of the entire average frost free period, and thus must risk damage by frost, as the data show that the date of the last killing frost in spring and the first killing frost in fall varies as much as a month from year to year. The hazard from the available growing season and the uncertainty of the occurrence of early and late frosts prompts the following advice by the Maine Agricultural Experiment Station: "The growing season in Maine is short, under the most favorable circumstances. Under present conditions, the farmer must take chances at one end of the season or the other. Often he plants in such a way as to take them at both ends. General observation shows beyond any question that the farmers who are most successful with sweet corn (that is, who make the most money at the factories year in and year out) are those who plant relatively early. That is, they elect to take their chance at the beginning rather than at the end of the growing season. At the worst, they may have to plant part of the piece over again. Whereas, if the loss is by frost in the fall, it is total and irreparable. Observation indicates that it should be a rule to plant as soon after May 15th as the soil is in condition."

However, early frost in the fall and nights when the temperature ranges near the freezing point are not always value-

less as they tend to decrease the activities of the ear worm and the corn borer.

The average annual rainfall in the sweet corn area of Maine ranges from 42–47 inches, except for Fairfield in the northern part of the region, which has only 35.3 inches. The lower annual rainfall at Fairfield is due to less winter precipitation, and the rainfall during the growing season at this station is not appreciably less than at some of the others. In general, there is a fairly uniform distribution of rainfall throughout the year, with most of the precipitation as snow during December, January, February, and into March.

This distribution during the growing season is uniform, averaging slightly above three inches every month, the harvesting season not being appreciably drier than the other months. The figures for rainfall over a period of years for each month indicate considerable variation from year to year and a distinct risk to the grower. No month during the growing season has any greater variation than any other. The average rainfall during July and August is sufficient for raising a good corn crop, but any great variation from the average often results in disaster. An abnormally rainy planting season causes activity among the cut worms and wire worms which destroy the seed before it breaks through the ground. Maine corn land, however, is only slightly infested with these pests.

The growing season weather usually consists of alternate periods of cloudy, rainy weather and warm, sunny days. At times during July and August, there may be periods of 2 to 4 days of sultry, sticky weather, with cloudy skies and relatively high humidity, followed by clearer, drier, and hotter days. The variation in weather from day to day depends upon the cyclonic movement, and the risks of the planter vary with these conditions.

FIGURE 4.—The seed corn is very carefully husked by hand and hung up under shelters to dry thoroughly. The selection and careful storage of seed forms one of the discriminating and critical items in the industry.

The only actual evaporation data available are the following figures for Gardiner, Maine, which show an average monthly evaporation (in inches) of 4.38″ in May, 4.76″ in June, 5.12″ in July, 4.54″ in August, 3.28″ in September, and 2.00″ in October. The mean daily rate of evaporation in thousandths of an inch for the period of the average

frostless season is between 100 and 120, distinctly less than in any other sweet corn area, with the exception of a small area in Minnesota. The ratio of precipitation to evaporation for the growing season is higher than in any other corn areas. The generally low evaporation rate results in higher quality corn, because the kernels remain in the milk stage longer and maintain their quantity of milk more easily during the time from picking to packing.

The average relative humidity at 8 A.M. is between 75–80 per cent in April, July, and October; at 2 P.M. it is between 55–60 per cent during the same months; and it is between 70–75 per cent in April, and 75–80 in July and October at 8 P.M. At Portland, the months of July, August, and September have the highest relative humidity, when the corn-canning industry needs the greatest amount of moisture in the air and the least evaporation to insure small loss of moisture from the kernels.

The danger from violent winds or hail is small and would tend to be of local rather than regional importance. Wind does attain storm strength occasionally in winter, less than twenty days a year; and hail falls in less than one day per year. Hot, drying winds may come in summer, but the probability of prolonged drought is less than in other parts of the United States, in fact, wellnigh negligible.

The sweet corn area in Maine lies in the so-called upland province of New England, a confused series of hill regions of varying height, separated by lake- and swamp-studded valleys with relatively narrow floors and bordered by gently sloping sides. The valleys and slopes range from 200–300 feet to 700–1,000 feet above sea level, while elevations of from 1,000 to 2,000 feet, scattered throughout the area, are usually designated as mountains. The hills and

FIGURE 5.—Much of the husking requires machinery, though in small plants the corn may still be husked by hand. Machinery is very extensively used in the canneries and substantially reduces the cost of operation.

ridges with gently sloping sides and rounded, level tops provide area for much of the cultivated land.

The soils of the area are derived from one of two general parent materials: glacial till or water laid deposits. The latter include stream-laid (or terrace), lake-laid or estuarine, and rich alluvial soils. Thus, the present soils are due to the action of weathering on these deposits. The soils of the sweet corn region might, therefore, be divided on the basis of derivation and processes of accumulation into the following groups: (1) Soils derived from glacial till; (2) soils derived from stream-laid, or terrace, deposits; (3) soils derived from lake-laid, or estuarine, deposits; (4) soils derived from alluvial flood plain deposits; (5) soils derived from the accumulation of organic matter; (6) miscellaneous soils.

In this region, it appears that the soils and topography have influenced the distribution of farming areas more than the distribution of crops. A marked general similarity in the varieties of crops grown on all soil types in the culti-

vated sections reveals itself. The stone content of the soil, and the topography have been governing factors in the distribution of cultivated areas in the uplands. The drainage conditions of the lowlands are important in the distribution of cultivated land in the areas of low elevation. The poorly drained areas are used for pasture and woodlot.

However, sweet corn seems to do best in a well-drained sandy loam. The acreage in corn is greater on the Gloucester sandy loam than on any of the other soils in Cumberland County. The following description of the type of soil in Cumberland County presents typical soil conditions under which the sweet corn is grown: "To a depth of 8–10″, the soil of the Gloucester sandy loam is a light brown to brown sandy loam, with a silt content to make it appear like a light loam. The soil is a brownish yellow to yellow sandy loam, which grades at about 24″ below the surface into a yellowish gray to gray material of slightly lighter texture. Gravel and large fragments of granitic rock are usually found in varying quantities throughout the three-foot section. Bowlders of similar rock, from small to large, are often quite common on the surface of unimproved parts of the type. Small, rounded outcrops of the underlying granite and small areas of shallow soil occur here and there. The type is not stony, in the sense of numerous small stones which interfere with cultivation. . . . The texture of this type grades heavy rather than light. The soil has a friable structure and a moderate organic matter content and may be handled under a varying wide range of moisture conditions. The soil has a fairly loose structure. The surface is undulating to gently rolling, or rolling to hilly. The type occupies hills and ridges, whose slopes toward streams and to the drainage courses are usually gradual and whose crests are, in most cases, broad and undulating to sloping. There is rarely any strictly level land within the type. . . .

"In general, the natural drainage of the type is good. There are some areas of shallow soil and steep slopes, whose drainage tends to be excessive. Springs and seepage cause wet areas on surface slopes. In many places, there are narrow strips along the drainage ways which are imperfectly drained. The water which falls upon the surface is quickly absorbed, and relatively little runs off the surface, except in the case of exceedingly heavy rains. . . .

"Although the majority of the sweet corn produced is grown on the Gloucester sandy loam, a small proportion is found on the sandy loam, heavy and light, of the Gloucester series. The Gloucester

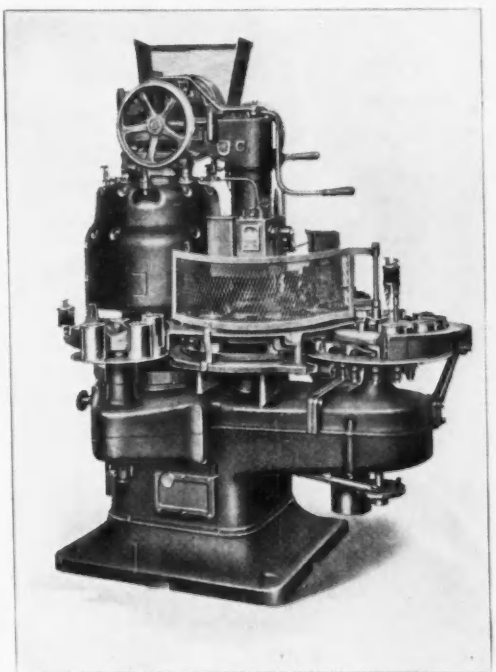


FIGURE 6.—A modern, up-to-date canning machine handles thousands of cans a day during the season. The high quality of Maine seed corn justifies the use of the most careful methods and the most expensive machinery in the preparation of the product for market. (Courtesy of The American Can Co.)

sandy loam differs from the stony sandy loam of the series in having a lower stone content and a less rugged topography. . . . It differs from the Gloucester stony sandy loam, light phase, in texture of fine material and in stone content."

Application of manure, phosphate, and wood ashes to Maine corn land is necessary to secure a profitable crop. Eight hundred to one thousand pounds of fertilizer to the acre is not too much for most Maine corn land. Proper crop rotation is also necessary to maintain soil fertility over a long period of years. Thus, suitable soil structure to insure proper mixture of the fertilizer is necessary.

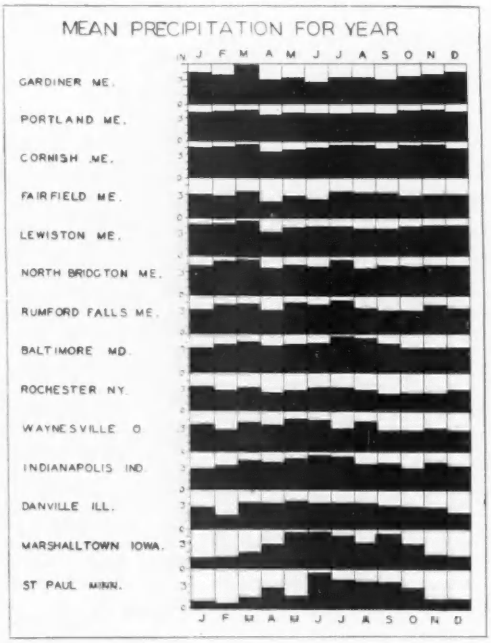


FIGURE 7.—The variation in the monthly mean precipitation for the year of the various seed corn producing sections of the country is well compared with Maine in this chart.

In addition to the climatic, topographical, and soil conditions in the sweet corn area of Maine, the type of seed, methods of planting, cultivating, and harvesting are important in insuring high quality sweet corn. The favorite varieties of sweet corn in Maine are "Golden Bantam" (introduced about 1900) with its crosses, and "Crosby" (introduced about 1860). Other varieties, for example, "Stowell's Evergreen," require a longer growing season, and, therefore, involve additional risk, because of danger of the loss of the crop due to frost.

The best results are secured from seed grown in the locality where the corn is to be raised, as is shown by extensive experiments and observations conducted by the Maine Experiment Station. Consequently the common interest of both the farmer and the packer demand not merely Maine-grown, but locally-grown, sweet corn seed selected for local adjustment. The selection of the seed must always remain in the hands of the packers to insure uniformity of pack and to enable them to select varieties and locations which will spread the packing season over several weeks. Relatively short distances between the canneries and the individual farms aid in the cooperation that is necessary between the packer and the farmer.

The time for planting seed varies with air temperature conditions during the spring and with the drainage conditions as dry land can be planted to corn earlier than moist land, because of its greater warmth. Experience indicates that the seeds should be planted as soon after May 13 as the soil is in condition. Under the most favorable circumstances the growing season in Maine is short. This means that the farmer must take chances at one end of the season or the other. Too often he so plants that he takes them at both ends. It is better for him to take the chances at the beginning of the growing season, for though then at the worst, he may have to plant a part of the land over again, he loses his whole crop if he hazards a late ripening. In many instances, the time of ripening is

determined by conference between farmers and the factory operators. Often the factory owner has kept records showing the best time of planting for a certain type of seed, and these figures, to supplement the farmer's experience, are of great aid. The factory owner also attempts to spread the planting period through several weeks, in order to be able to harvest crops from different fields at different periods of time. In this way, the canner has a longer period for packing, requiring less machinery and a smaller labor supply.

The harvesting of sweet corn in Maine is probably one of the best examples of how science can be applied to agricultural crops to achieve high grade of product. The harvesting problems of the Maine packer and the farmer center around two main points: first is the problem of when to pick the sweet corn, in order to secure the largest amount of moisture and sugar in the kernels; and secondly, how to maintain that sugar and moisture content in the kernels during the movement of the crop from the fields to the cannery. Studies of the changes in the composition of sweet corn during the ripened period show that the quantity of starch increases and the quantity of sugar and moisture decrease as the corn ripens. The problem of picking the corn then resolves itself into the question of determining when the kernels contain the maximum amount of sugar and moisture that experiments and practice show that that particular variety should contain. During the later stages of maturity, the kernels pass through the pre-milk, milk, early dough, and dough stages. The corn is canned in the milk stage to produce the best results. If harvested in the pre-milk stage, the yield per ton is low, and the canned product lacks body. If harvested in the early dough, or dough, stages, the product lacks in flavor, and is tough and starchy.

Many experiments have been made in order to devise a system for testing sweet corn, in order to determine the best canning stage. There are, at present, two methods used in general to determine when sweet corn will be in the packing stage. The first method is based on the toughness of the kernels. When corn shows a toughness of about 300–325 grams when tested with an instrument

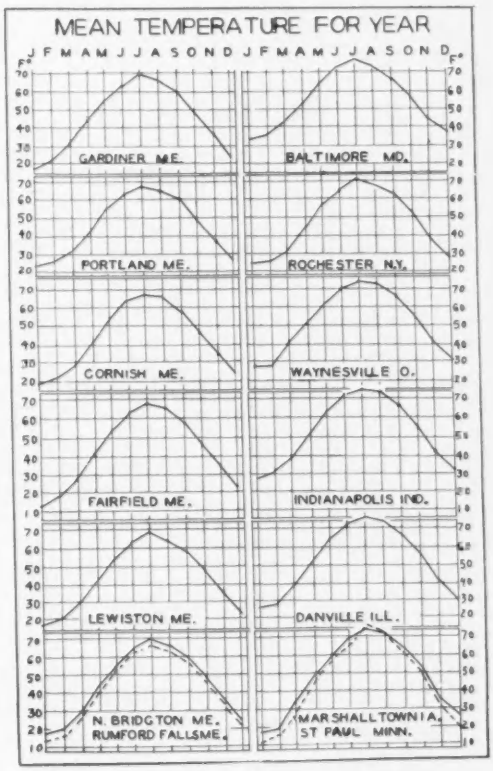


FIGURE 8.—The monthly mean temperatures for the year of the Maine sweet corn producing section compared with those of other sections of the country shows that Maine has some slight advantage over them.

devised by Culpepper and Magoon, it is about right for canning. At this stage, sweet corn is sufficiently tender, has lost little of its maximum sugar content, and yet is mature enough to yield well and make a canned product of proper consistency. Tests show that the Crosby corn in Maine is ready for canning at about thirty-five to forty days from the

time the first silk appears, and it remains in good condition for about five days. The second method used was worked out by Dr. Appleton of the Maryland Experiment Station. The rate of ripening of sweet corn is largely dependent on temperature. Dr. Appleton found that "Evergreen" corn planted early, so that it ripened in August, developed much faster than corn planted so it ripened in the autumn. In predicting the probable date of ripening, the pre-milk stage is used as a basis for the prediction. At this time the husks are not firm and the silk is not dry; the kernels are small, spherical, and somewhat separated. The

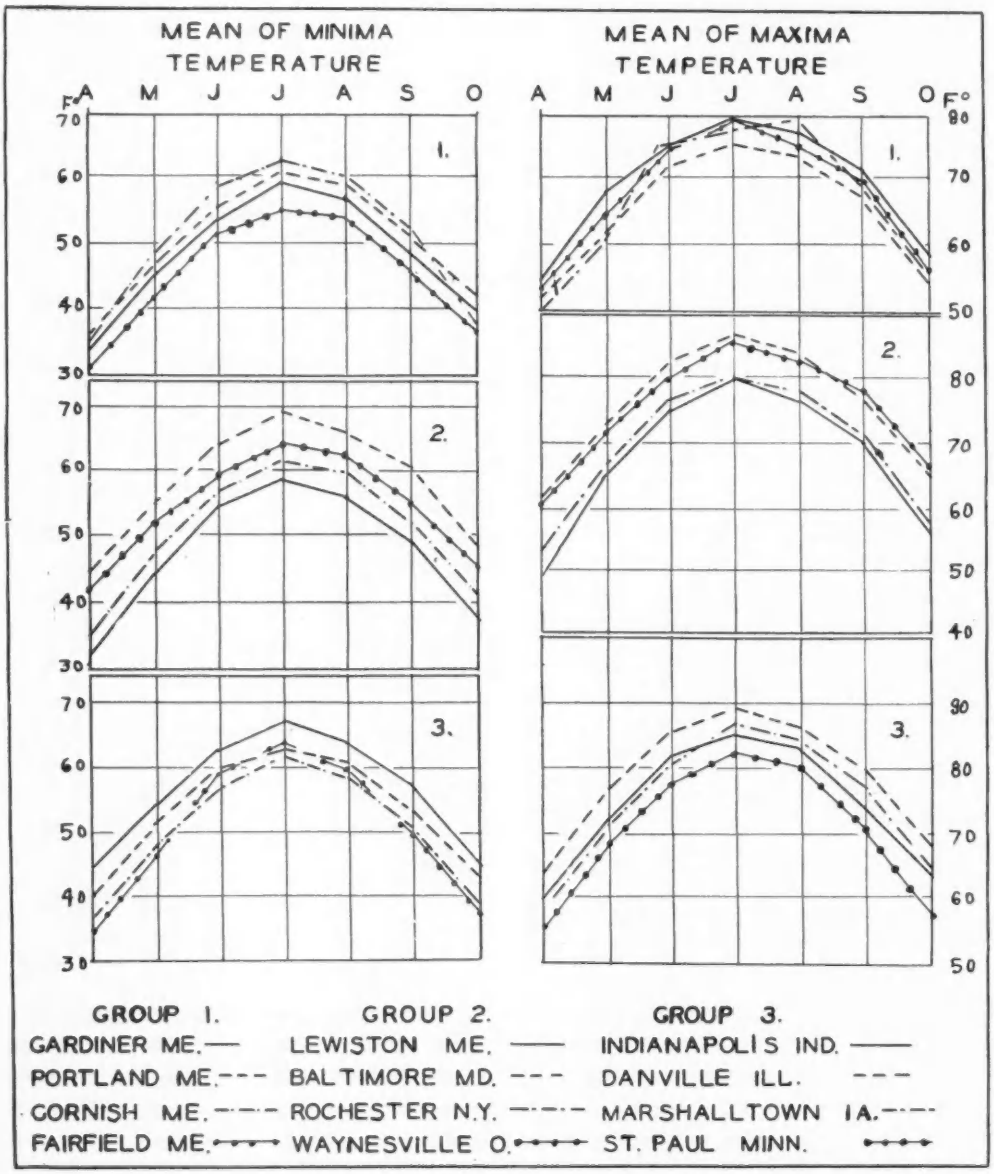


FIGURE 9.—A comparison of the mean minima and mean maxima of the temperatures of the Maine section compared with the other sections of the country throws further light on the relative superiority of Maine sweet corn.

contents of the kernels are opalescent, or cloudy, but not milky. At an average temperature of 60° F. the sweet corn passes from pre-milk to the best canning stage in fourteen and one-half days. At an average temperature of 70° F., the time between the pre-milk and the best stage was ten days, while at a temperature of 80° F., the time was reduced to seven days. Therefore, the time between the pre-milk and the best edible stage decreases with an increase in temperature. At Portland, Maine, in the first half of September, the time between the pre-milk and best canning stage is about fourteen days, while from September 15–31, the time between pre-milk and best canning stage is sixteen days. This is based on average climatic conditions. Divergents from the average climatic conditions necessarily make prediction harder. In general, however, the probable date of maturity can be predicted within several days.

The temperature at the time of ripening is not only of value in predicting the time of maturity, but it also has considerable influence on the length of time which the corn remains in suitable condition for canning. At an average temperature of 60° F., Appleton found that sweet corn remains in a suitable condition for canning for five days; while at an average temperature of 80° F., the corn remains in a suitable condition for canning only two days. (Table shows the effect of temperature on the rate of ripening of sweet corn in different localities.) The contrast between Charleston, South Carolina, where sweet corn remains in edible condition for only about two days, and Portland, Maine, where it remains in edible condition for four or five days, accounts for the superiority of Maine sweet corn. The ripening period proceeds so slowly, that there is plenty of opportunity in most cases to get the corn to the factory before it becomes too starchy. Maine has the advantage over areas where the temperature during the picking season is higher, and where a delay of a day or two is likely to result in inferior quality.

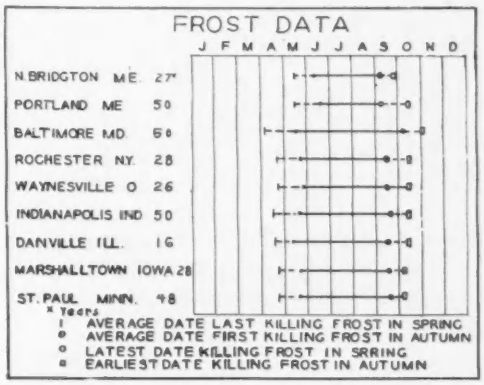

FROST DATA
J F M A M J J A S O N D
N.BRIDGTON ME. 27
PORTLAND ME 50
BALTIMORE MD. 60
ROCHESTER NY. 28
WAYNESVILLE O 26
INDIANAPOLIS IND 50
DANVILLE ILL. 16
MARSHALLTOWN IOWA 28
ST. PAUL MINN. 98
Years
AVERAGE DATE LAST KILLING FROST IN SPRING
AVERAGE DATE FIRST KILLING FROST IN AUTUMN
LATEST DATE KILLING FROST IN SPRING
EARLIEST DATE KILLING FROST IN AUTUMN

FIGURE 10.—The length of the growing season, as determined by the last frosts in spring and the first frosts in autumn, is appreciably shorter in Maine than in other sweet corn producing sections.

The quality also depends on the length of time that it takes to move the corn from the field to the factory. Sweet corn loses its sugar content very rapidly after it has been picked. The warmer the weather, the more rapid is the decrease in sugar content, and consequent decrease in quality, a decrease which follows, even though sugar content is not the sole factor in determining the quality of sweet corn; for corn which has been held for a day or two at a warm temperature becomes inferior in quality. Experiments show that sweet corn held twenty-four hours after picking at a temperature of 32° F. loses very little of its sugar, but at 85° F. about 60 per cent of the sugar is lost. Even at a temperature of 50° F., 20 per cent of the sugar is lost during the twenty-four-hour period.

The cool season in Maine undoubtedly plays an important part in maintaining sugar content during the period when the corn moves from farm to factory. The average temperature in

Maine during September is between 50° F. and 60° F., a cooler harvesting season than other sweet corn areas in the United States, so that, even in Maine, more than a 20 per cent loss in sugar content between the time of picking and packing the corn is likely. These conditions are reflected in the practice of the canners who keep their shops open until the day's supply of corn is all canned and in the growing of the corn in fields at an average distance of only seven and one-half miles from the canneries.

As the harvesting season approaches, factory representatives visit the various fields and test the corn, to determine the best date for picking and how much corn may be expected at the cannery during each day of the packing season. The close supervision of the corn acreage by the canner is one of the ever increasing examples of coöperation between industries using farm products and the producer. The farmer usually signs a contract, specifying the number of acres of corn he will grow and signifying his agreement to harvest it when the packer desires. If he does not measure up to his agreement, he may find his corn rejected by the packer. The husks and cobs are used by the farmer as silage and fertilizer.

The seasonal nature of the corn canning industry presents two further problems to the cannery owner. First, he must find other uses for his canning machinery during the time before and after the corn harvest. This method is usually met by canning other vegetables, such as beans. The second major problem is to secure labor when the corn is in the canning stage. This seasonal demand for labor is filled in Maine by workers from industries which are operating below average labor requirements at the time of the corn harvest, such as the textile mills. In addition, the corn canning period comes when summer camps have closed and tourist trade has declined, resulting in the release of numerous laborers who depend on seasonal industry for an income.

Most of the sweet corn packed is sent to large wholesale houses. The corn factories, in general, do not maintain marketing organizations, although in many cases, the factory owner coöperates with the wholesaler, and through him with the retailer, in advertising the product. This is done either by making special labels for individual wholesale houses, or by sending factory representatives into the field along with wholesale salesmen to demonstrate the characteristics and quality of Maine grown corn. One of the larger packers in Maine has employed men in this type of work on the Pacific coast for several years. The corn is shipped by rail to consuming centers in the East and Middle West. Corn destined for the Pacific

FIGURE 11.—Southwestern Maine constitutes the area of general distribution of sweet corn canneries.

coast moves by way of the Panama Canal. The shipping of corn by water requires the packing of the cans in wooden boxes, rather than in fibre containers. A few large companies, as the Atlantic and Pacific Tea Company, buy directly from the factory. The great Atlantic and Pacific Tea Company uses its own trucks in moving the corn from the factories to their stores.

The foregoing statements would seem to indicate that the Maine sweet corn industry enjoys a distinctive and enviable position in the industry as a whole. At the moment, however, this is not true. The corn industry in Maine is faced with the possibility of a decline in the importance and value of its product, and thereby commercial ruin, because Maine sweet corn packers have failed to educate the public to appreciate the difference between medium and high quality sweet corn.

The advantage of quality which the Maine corn growers enjoy is being offset by competition from producers in the Middle West. The cool nights of the continental Middle West approximate the cool weather of Maine; and where the corn is husked before or by sunrise, and delivered to the cannery at once, as many Midwest packers require, the quality of the product approaches that of Maine corn closely enough to compensate by the lower price. The difference in price between a fair can of corn and a high quality can seems to be the determining factor when the consumer goes to market, rather than the quality of the product.

EFFECT OF TEMPERATURE ON RATE OF RIPENING OF SWEET CORN IN DIFFERENT LOCALITIES*

Location	*Picking Season*	*Length of Time in Best Edible Stage*
Charleston, S. C.	June 17–31	2.5 days
	July 1–15	2.0 days
Baltimore, Md.	Aug. 1–15	2.5 days
	Aug. 15–31	3.0 days
New Haven, Conn.	Aug. 1–15	3.0 days
	Aug. 16–31	3.5 days
Portland, Maine	Sept. 1–15	4.5 days
	Sept. 16–30	5.5 days

Showing the effect of temperature on the rate of ripening of sweet corn in different localities. In the southern states where the temperature is comparatively high at picking time the corn remains in the best edible stage only two or three days. In Maine, however, where the corn is picked during the cool autumn period the corn remains in the best canning stage for four or five days. Because of the cool weather in Maine at picking time, it is easier to get the corn to the factory in prime condition than it is in the states farther south. This is one reason for the high quality of Maine packed sweet corn.

* Maine Agricultural Experiment Station Report, 1926. Bulletins 329–335, page 139, table 4.

TABLE I

CORN, SWEET, COMMERCIAL CROP FOR MANUFACTURE

(Production by States, 1928–1931*)

State	*Production by States*			
	1928 (Tons)	*1929* (Tons)	*1930* (Tons)	*1931* (Tons)
Maine	30,200	46,000	48,800	35,700
New York	32,400	36,900	29,900	43,200
Ohio	39,100	62,000	35,800	72,700
Illinois	128,300	134,400	144,000	164,600
Indiana	38,300	50,000	56,600	83,600
Wisconsin	29,600	24,400	31,200	28,800
Minnesota	85,800	109,900	129,600	88,100
Iowa	99,600	125,000	110,000	123,700
Maryland	63,200	61,600	23,800	71,600
U. S. Total	592,900	704,400	659,700	771,800

* U. S. Department of Agriculture Yearbook, 1932, page 710.

TABLE II

CORN, SWEET, COMMERCIAL CROP FOR MANUFACTURE

(Acreage by States, 1928–1931*)

State	*Acreage*			
	1928	*1929*	*1930*	*1931*
Maine	10,770	14,850	13,200	10,200
New York	27,000	24,600	23,000	17,300
Ohio	27,910	31,000	32,500	30,300
Illinois	58,300	64,000	72,000	68,600
Indiana	27,390	38,500	43,500	38,000
Wisconsin	14,780	11,600	13,000	12,500
Minnesota	33,000	45,800	54,000	48,700
Iowa	39,860	50,000	55,000	53,800
Maryland	35,500	44,000	34,000	39,800
U. S. Total	305,960	357,310	375,560	350,560

* U. S. Department of Agriculture Yearbook, 1932, page 710.

TABLE III

CORN, SWEET, COMMERCIAL CROP FOR MANUFACTURE

(Yield per Acre, 1928–1931*)

State	*Yield per Acre†*			
	1928 (Tons)	*1929* (Tons)	*1930* (Tons)	*1931* (Tons)
Maine	2.8	3.1	3.7	3.5
New York	1.2	1.5	1.3	2.5
Ohio	1.4	2.0	1.1	2.4
Illinois	2.2	2.1	2.0	2.4
Indiana	1.4	1.3	1.3	2.2
Wisconsin	2.0	2.1	2.4	2.3
Minnesota	2.6	2.4	2.4	1.8
Iowa	2.5	2.5	2.0	2.3
Maryland	1.5	1.4	.7	1.8
U. S. Total	1.94	1.97	1.76	2.20

* U. S. Department of Agriculture, Division of Crop and Livestock Estimates.

† Tons of 2,000 pounds.

TABLE IV

CORN, SWEET, COMMERCIAL CROP FOR MANUFACTURE
(Seasonal Farm Price per Ton, 1928–1931*)

State	Price per Ton			
	1928	*1929*	*1930*	*1931*
Maine	$24.70	$24.70	$26.30	$19.30
New York	16.50	17.00	17.50	17.00
Ohio	10.80	11.20	11.30	9.90
Illinois	12.70	12.60	13.00	10.60
Indiana	13.00	13.00	13.20	11.00
Wisconsin	11.50	11.80	11.10	10.10
Minnesota	10.80	11.00	10.40	10.10
Iowa	9.30	9.90	10.50	9.50
Maryland	14.00	15.00	14.50	11.70
U. S. Total	12.68	13.14	13.24	11.32

* U. S. Department of Agriculture Yearbook, 1932, page 710.

TABLE V

CORN, CANNED—PACKED IN THE UNITED STATES, 1928–1931*
(Stated in Cases of 24 No. 2 Cans)

State	Season (*1,000 cases*)			
	1928	*1929*	*1930*	*1931*
Maine	966	1,521	1,930	1,245
New York	666	782	647	1,080
Ohio	1,138	1,551	750	1,871
Indiana	1,131	1,250	1,272	2,362
Illinois	3,017	3,153	3,261	3,788
Wisconsin	578	547	686	712
Minnesota	1,648	2,604	2,912	1,835
Iowa	2,541	2,908	2,552	3,227
Maryland	1,648	1,865	622	1,956
U. S. Total	14,497	17,487	15,692	19,415

* U. S. Department of Agriculture Yearbook, 1932, table 206, page 711.

TABLE VI

ACREAGE PLANTED TO SWEET CORN FOR CANNING
(By Counties, in Maine)

County	Acreage		
	1929	*1930*	*1931*
Oxford	2,954	2,496	2,156
Somerset	2,773	2,559	2,101
Kennebec	2,637	1,983	1,503
Franklin	1,424	1,338	887
Androscoggin	1,304	1,289	1,163
Waldo	1,257	1,128	1,091
Penobscot	1,164	878	439
Cumberland	1,152	835	601
York	586	576	469
Knox	239	222	202
Lincoln	127	123	64
Piscataquis	11	9	9
Total	15,628	13,436	10,685

FUTURE OF LAKE SUPERIOR IRON ORE SUPPLY

George H. Primmer

FOR nearly fifty years more than half, and for longer than a quarter century past, in excess of three-fourths of the iron ore mined within United States (Figure 1) moved from Lake Superior district towards consuming areas, in general, lying southeast (Figure 2).

Beginning and Development of Ore Shipping

One hundred thirty-two tons of iron ore on the brigantine "Columbia" passed through St. Mary's canal in August, 1855, the first such cargo taken from upper to lower lake ports without breaking bulk. Lake Superior ore shipments mounted slowly till after 1880, and rapidly not till some time after the opening of Mesabi Range. Lake Superior district then began to supply an increasing share of national iron ore consumption; demand rose with population increase and with growth of per capita consumption of iron and steel, a consumption that by 1900 measured seven-fold that of a half century previous, and more than four times that of thirty years earlier.

Average annual shipments for the decade 1921–1930 surpassed fifty million tons, reaching an all-time peak in 1929 when some sixty-three million tons moved from six upper lake to nearly three times as many lower lake ports. Some years after peak shipment the lake ore fleet yet consisted of some three hundred thirty vessels. Their combined carrying capacity, on the nineteen foot draft then current, totalled 2,780,500 tons per round trip. Since lake carriers can make as many as twenty-five round trips per season past records could fall without further additions to the ore carrying fleet.

Following the first forty years of shipping ore from Lake Superior area, new discoveries seemed imminent enough to provide for all future demands; after a second four decades, with shipment proceeding at a much faster rate than during the first, a student of the iron ore industry finds the district confronted with a very real problem of adequacy of supply for future shipments. Published estimates of life of iron ore shipping range from cessation of significant movement from Lake Superior some time between 1950 and 1960, and a possible continuation of shipments until some five thousand years later. This article proposes no absolute forecast of the date of the concluding shipment of Lake Superior iron ore. Its purpose consists rather in setting forth briefly some of the considerations which should guide geographic thinking concerning the future of the region as an ore producer.

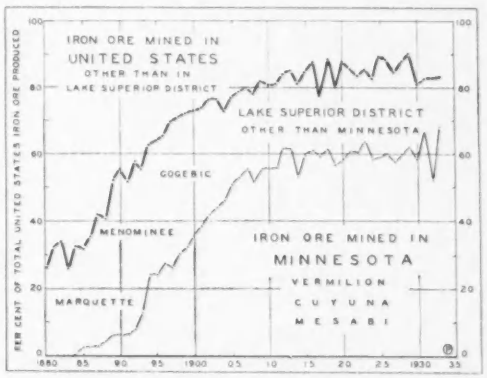


FIGURE 1.—For a generation past Lake Superior district produced an average of eighty per cent of all iron ore mined in United States. Most of Lake Superior ore lay within Minnesota where the Mesabi yields most heavily.

RESERVE OF LAKE SUPERIOR REGION

Except for those comparatively few spots where outcrops revealed deposits, explorers seeking iron ore around Lake Superior chose from a number of methods including magnetic surveys, test pitting, and drilling. Drill holes, made in softer material by churn drills and in hard rock by diamond drills (Figure 3), furnished most knowledge of sub-surface deposits. Samples from diamond drilling include drill cores which make possible the more satisfactory measurements and analyses. Even for deep lying deposits fairly accurate estimates of volume of ore of various grades prove possible. Quality and specific gravity indicate a range from less than nine to more than twenty cubic feet per ton of ore or of concentrate.

Future shipments of Lake Superior iron ores, manifestly, depend on the regional reserves whose estimated totals constantly fluctuate through removals and through re-definition of what constitutes assured reserve. Recent official estimates for Lake Superior district show less than one and a half billion tons of assured (Figure 4), and a somewhat smaller probable reserve. Length of future shipping period does not derive directly from knowledge of assured reserve and average annual tonnage shipped. To some extent discoveries of earlier unknown ore and, in much greater amount, change from probable to assured reserve of ores amenable to new methods of processing, result in a depletion of assured reserve only about one half as great as shipments of recent years. Conceivably, beneficiation might

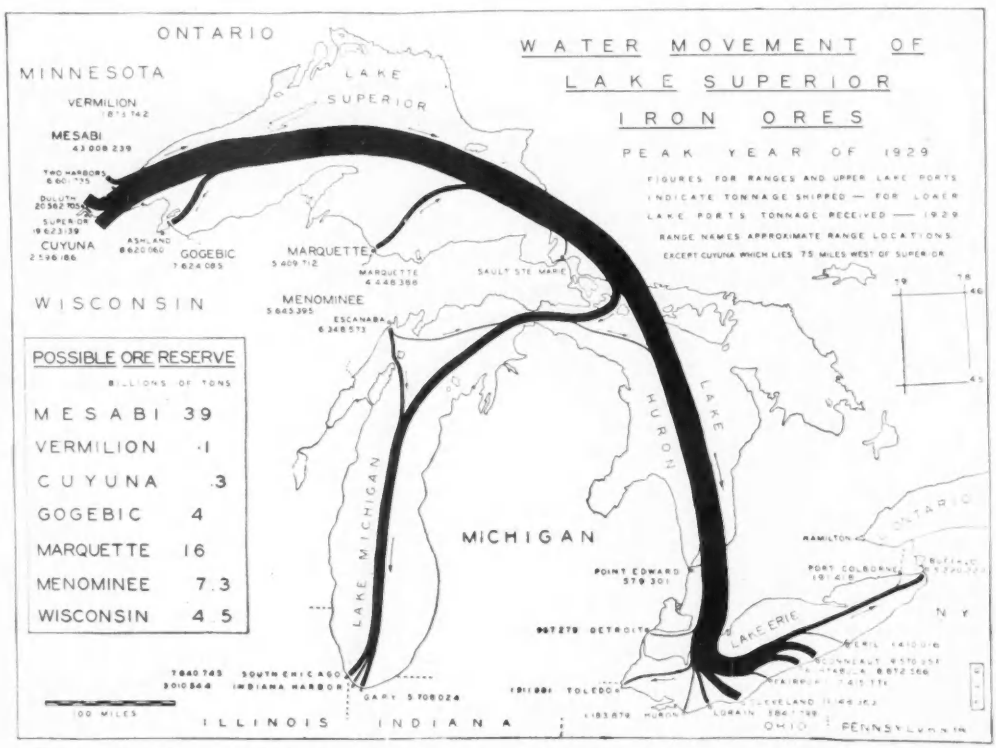


FIGURE 2.—Nearly all Lake Superior iron ore moves southeast by water. Receiving ports on the lower, greatly exceed in number shipping ports on the upper lakes.

develop to the extent of full maintenance of present reserve for an indefinite period.

In 1910 Lake Superior reserves included fifty-seven tons of ore for each ton of annual smelting capacity of blast furnaces using ore from the region. Increase in furnace capacity and in resultant ore demand, along with a small decrease in reserves, by 1920 decreased the ratio of reserve tonnage to smelting capacity to thirty-six; and by 1930 the ratio dropped to thirty-two. Regional estimates, obviously, give no direct knowledge of reserve status of any one company operating within the region. Some companies have so high a reserve as to make its maintenance unduly expensive; others control so small a reserve as to make insecure their plans for continuing operations in a rather immediate future. Companies of low reserve, to continue in business, must perforce soon acquire more in Lake Superior district or elsewhere.

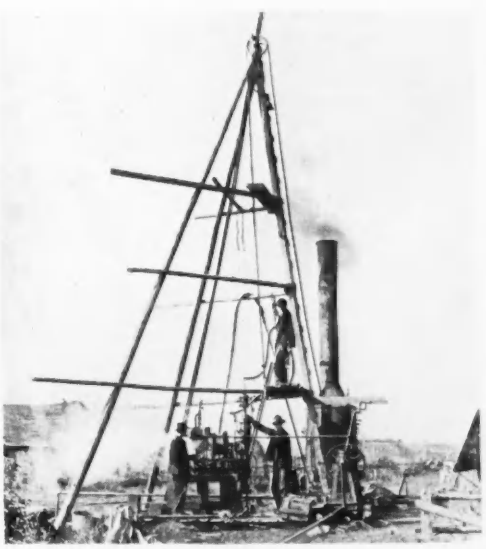


FIGURE 3.—Exploration drill outfit. Such equipment using a diamond drill furnishes hard rock cores for determining quantity and quality of underground ore deposits. Churn drills operate in drift and in less resistant rock. Lake Superior district contains tens of thousands of test holes. (Photo by Gallagher, Duluth.)

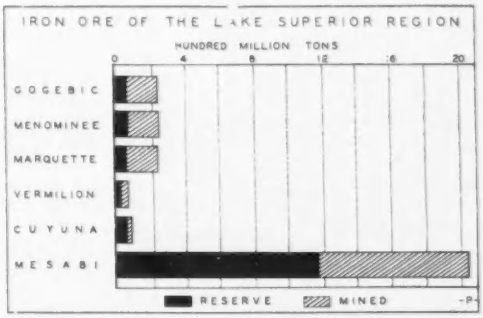


FIGURE 4.—Only assured reserves show on this chart. Probable reserves total almost as much and possible reserves many times the assured.

BENEFICIATING OF LAKE SUPERIOR IRON ORES

The district boasts well over a billion tons of probable ore, a reserve but slightly smaller than the assured reserve. Besides, vastly greater amounts of low grade ores, through new types of processing or commercial application of processes now known, may become available. More than forty plants now beneficiate Michigan and Minnesota ores.

Most concentration in Lake Superior district involves improvement of silicious ores by washing. Early this century a Cedartown, Georgia, plant received an experimental carload. Mesabi operators soon after built a small plant. They began the large Coleraine plant (Figure 5) in 1909 and completed the fifth unit in the spring of 1911. Trout Lake provides it with (1) clear water for the power plant, (2) a place to dispose of tailings, and (3) an abundance of wash water through a forty inch four hundred foot steel intake pipe. The five units of this one large plant produced more than two and a half million tons of concentrate in 1912. The district beneficiated nearly seven million tons in 1933, of which Minnesota produced nearly five million tons largely by washing (Fig. 6).

After trying out an experimental mill built at Duluth in 1916, the Mesabi Iron Company erected the first unit of a commercial plant at Babbitt, Minnesota, to

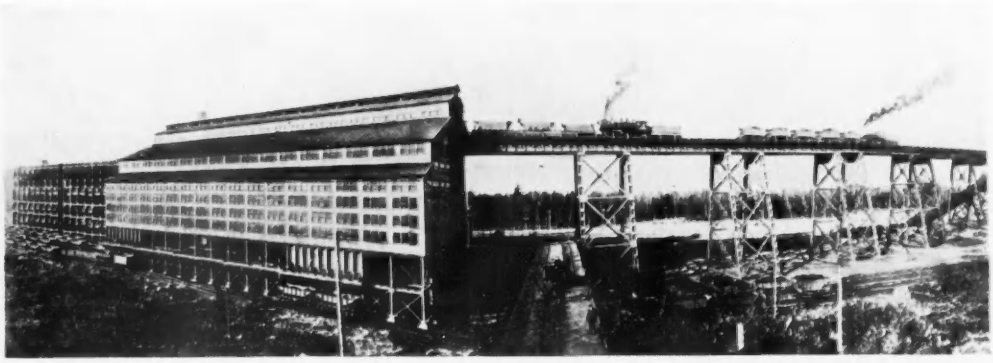


FIGURE 5.—Trout Lake concentrator near Coleraine, Minnesota. Western Mesabi lean sandy ores, through washing, yield a product of satisfactory iron content. (Photo by Gallagher, Duluth.)

process lean magnetic ores of the vicinity, hard ores analyzing about twenty-eight per cent iron. The plant maintained activity from 1922 to 1924, grinding the low grade ore in a ball mill and magnetically removing a concentrate which it sintered into a shipping ore of around sixty-five per cent iron. The product sold for about $1.50 per ton above the usual prices for the ores showing fifty-two per cent iron, for some years mean content of shipments from the region. The plant, now in its tenth year of idleness, awaits prices that again shall justify its activity.

For the most part lean ores of Lake Superior district comprise non-magnetic types, in which iron oxide and silica lie mixed so intimately that as yet no economical commercial process for beneficiation has been announced. Experimental processing includes (1) fine crushing, (2) separation, and (3) agglomeration into strong porous lumps suitable for blast furnace use. Roasting of ore before separation, for which natural gas might be piped to furnish a satisfactory cheap fuel, makes possible a magnetic concentration. Profits will flow from such beneficiation of ore only when it can be done more economically or when concentrate prices rise. Experimenters expect to have made these ores available before they become absolutely necessary to bolster up the regional reserve (Figure 7).

TAXATION AND IRON ORE EXPLOITATION

State and local taxing units collect a significant portion of their operating

FIGURE 6.—The rapid rise after 1922 marks an increase largely in crushing and screening, changes not increasing iron content of ore. Bureau of mines records, based on a more restricted meaning of beneficiation, show but fifteen to twenty per cent for recent years.

revenue from Lake Superior mining property. The total tax levy per ton of ore shipped from St. Louis County, Minnesota, rose from forty-one cents in 1929 to nearly nineteen times as much in 1932, the higher tax figures indicating a relatively small shipment for 1932. Twenty-six communities of St. Louis County procure an average of some ninety-four per cent of their total tax income from iron ore properties. Stuntz Township, including Hibbing, possesses a valuation one half greater than that of the entire city of Duluth. Though Stuntz contains scarcely one-fifth the population its total tax levy of $5,531,-196.73 closely approaches the $5,850,-420.52 of Duluth. Leonidas recently levied 98.9 per cent and Franklin 99.9 per cent of total taxes on mine property.

Mining companies failed to pay much of the tax for 1932 and now seek relief in the courts. Advocates of collection of the full amounts of the taxes levied plus accrued penalties for delinquency maintain that corporation reserves may as well apply to taxes as to dividends.

A 1932 study indicates that in recent years in both Michigan and Minnesota mining companies divert about twenty-five per cent of "true net profit" to payment of taxes. Utilization of lower grade ores probably would receive stimulus from a lesser tax burden; taxing units already consider advisability of but a nominal tax or entire freedom from taxation of the lowest grade ore now amenable to beneficiation. Encouragement of ore processing on a large scale might develop taxable wealth in ore bodies at present not thought valuable.

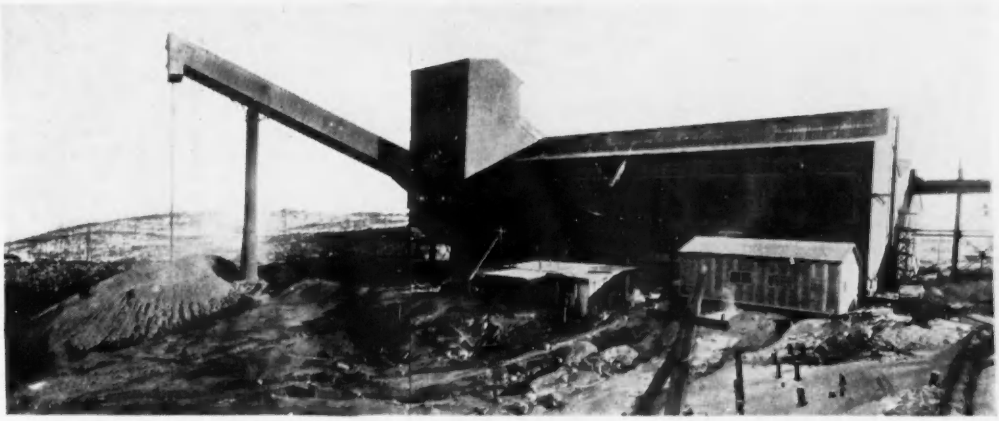


FIGURE 7.—Concentrating plant for eastern Mesabi hard magnetic ore producing a sixty-five per cent sinter from ore of less than half that iron content. (Photo by Gallagher, Duluth.)

PROBABILITY OF NEW ORE DISCOVERIES

For each fourteen tons of ore mined in Michigan in the seventy years immediately preceding 1914 thirteen accessible tons remained. Rate of use with no

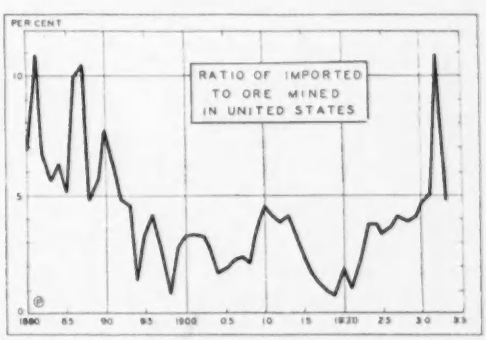


FIGURE 8.—Decline in the ratio of import to domestic iron ore accompanied development of mines in Lake Superior area. The recent rise in the ratio reflects primarily low domestic production.

allowance for additions to reserves indicated exhaustion in seventeen years. More than seventeen years later Michigan lists reserves more than five-sixths as large as in 1914. This seeming anomaly a state report partly explained in advance. It referred to unexplored and partly explored mineral lands, and to probable discoveries attending contemplated deep level exploration. Even in Minnesota new finds yet remain likely, for with an assured reserve of well over a billion tons little incentive exists for current exploration seeking iron ore deposits.

FIGURE 10.—Modern type electrically operated shovel in Mesabi open pit mine. The cable, dragged from the rear as the caterpillar tread moves the outfit forward, carries current from a northeast Minnesota power line net. St. Louis River, descending from peneplain to lake plain, provides much of the power. (Photo by Gallagher, Duluth.)

POSSIBILITY OF DECLINE IN DEMAND FOR IRON ORE

Aluminum and copper, both produced much more cheaply than formerly, replace iron and steel for numerous uses. Probably substitutes of all kinds tend to lessen demand for new iron ore far less than use of scrap. Addition of scrap reduced by one-eighth to one-fifth the average amount of iron ore used for each ton of iron and steel products made in United States. Substitution and reuse, patently, tend to prolong producing life of ore areas.

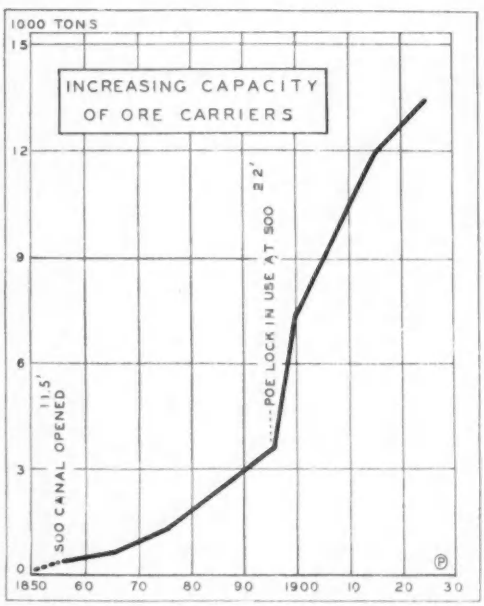


FIGURE 9.—Newly built ore carriers, as a rule, have approximated the maximum size permitted by minimum channels along the route used. The twenty-four and a half feet Soo depth, dating from 1914, will soon be matched by that of the chief lake harbors. This will invite larger carriers and permit loading to much deeper draft many now in use.

COMPETITION OF ORES FROM FOREIGN LANDS

Imported iron ore, though entering United States in increasing quantities in recent decades, shows no alarming percentage increase. From 1892 to 1931 imports for each year amounted to less than five per cent of national production. Recent increase in this ratio (Figure 8), more apparent than real, came only with very low production of domestic ores, a condition presumably but temporary.

IMPROVED SHIPPING AND MINING

Continued increases in size of ore carriers on the lakes (Figure 9) exemplify betterments tending toward cheaper ore for eastern furnaces. Since 1914 the larger Soo locks offer a water depth of some twenty-four feet. Probably current deepening of lake harbors to similar depth will initiate a great increase in average load transported by ore carriers. Improved electric haulage in un-

derground mines; standard gauge electric locomotives in open pits; electrically operated three hundred ton shovels; and drag-line excavators, stripping forty foot layers, typify equipment being modernized or installed and later reflected in lowered mining costs (Figure 10). Though improvement of machinery tends to increase rate of ore removal, probably only further improvement can continue to keep Lake Superior ranges a major source of iron ore supply.

CONFIDENCE OF INDUSTRY IN FUTURE OF LAKE SUPERIOR AREA

Besides improvements and modernization previously mentioned, numerous other investments of fixed capital in Lake Superior district indicate a confidence in a long future for ore production. Railroads admirably illustrate the point. On one line 99.75 per cent of the cars returned empty to the mine area. Railway executives testified that much of the iron country seemed incapable of agricultural development, enough to support a railway being deemed humanly impossible. Outside mining areas proper the territory using Lake Superior iron ore expresses most confidence. In 1902 it produced less than eleven per cent of United States pig iron. By 1930 it increased its output to nearly twenty-three per cent of that of the nation. Such expansion indicates faith in ability to procure ore for an indefinite period.

THE LOS ANGELES HARBOR FISHING CENTER

Clifford M. Zierer

WITHIN the past two decades Los Angeles rose from a position of relatively minor significance as a fishing port to a place among the leading fishing centers of the United States. In 1929, receipts of fish in Los Angeles County amounted to 373 million pounds, an amount 45 per cent greater than was landed at Boston, the principal center on the Atlantic coast. The value of the catch to the fishermen at Boston, however, was more than twice as great as that at Los Angeles, which was valued at $5,000,000, owing to the fact that nearly three-fourths of the tonnage received at the latter port consisted of the inexpensive sardine or pilchard.

The value of manufactured products obtained from the fishery at Los Angeles in 1929 was estimated to be nearly $25,000,000. Approximately $15,000,000 were invested in canneries and in fishing boats and other equipment. The industry provided a livelihood for some 5,000 workers with an annual payroll of more than $7,000,000. Probably twenty or twenty-five thousand persons, therefore, were directly dependent for their livelihood upon fishing at Los Angeles harbor. Three-fourths of the licensed fishermen were foreign-born.

FIGURE 1.—Aerial view of Los Angeles Harbor with Fish Harbor near the center of the picture. The government breakwater is in the foreground. The manner in which Terminal Island sand spit has been widened by deposit of materials dredged from the Inner Harbor is shown. The new basin added to Fish Harbor in 1932 does not appear. The town of San Pedro lies to the west (left) of the harbor and Wilmington to the north. (Courtesy Los Angeles Harbor Commission.)

The importance of Los Angeles as a fishing center may be attributed almost wholly to the recent development of extensive canneries in which the sardine, five varieties of tunas, and mackerel have furnished the raw materials. The catch to supply fresh fish markets amounted to less than 5 per cent of the total landings at Los Angeles in 1929 in spite of the relatively large local market for such products. A brief account of the growth of the fishery and a more detailed characterization of the local fishing community will be attempted.

ESTABLISHMENT OF CANNERY INDUSTRIES

A limited local demand similarly prevented any large expansion of the fishery to supply fresh fish markets. Market fishing operations had for several decades been conducted from a number of scattered beach towns on Santa Monica Bay, chief among which were Santa Monica, Playa del Rey, and Redondo Beach, as well as at San Pedro, Wilmington, and Long Beach, which three constitute the modern Los Angeles harbor district. In many instances the early fishermen engaged in other occupations such as agriculture during most of the year.

EARLY SARDINE CANNING

As early as 1893, a small sardine cannery was established at San Pedro (now a part of Los Angeles) and the expansion of the industry was confidently predicted by those cognizant of the great quantities of sardines (*Sardina caerulea*) available on the inner margin of the continental shelf within 25 miles of that port. Unsuccessful attempts were made during the next half-dozen years to prepare other varieties of local fish. Limited market determined the intensity of sardine fishing operations, and, in spite of discovering a satisfactory method of canning the product, the industry made little growth for a number of years.

EARLY TUNA CANNING

In 1905, owing to a temporary scarcity of sardines, the cannery at San Pedro experimented with canning albacore (*Germo alalunga*) one of the species of tuna then abundant locally during the summer months. In 1906 tuna canning was begun on a commercial scale due to increased difficulties in competing with better known Norwegian and Maine sardines on domestic markets. By 1909 a satisfactory method of canning the choice white meat of the albacore had been developed, and the canning of sardines was temporarily abandoned at San Pedro in favor of the choicer product.

In succeeding years additional tuna canneries were constructed at Los Angeles and San Diego harbors until, in 1916, there were 16 canneries in southern California employing 1,800 workers and valued at approximately a million dollars. Nearly 400 small motor boats manned by some 1,200 men were engaged in the tuna fishery. Trolls with artificial lures called "jigs," and hand lines baited with live sardines constituted the most successful fishing gear.

In 1917, the peak year of the albacore fishery, 34 million pounds were taken in southern California waters. The dominant position of Los Angeles in the albacore fishery was based on the rich summer harvests of that migratory species secured in the deep channels lying between the scattered off-shore islands, especially Catalina, and the mainland.

In 1918, due to a marked reduction in the albacore catch, other species of tuna were taken locally to meet the growing demands of canneries. Bonito (*Sarda chiliensis*), striped tuna (*Katsuwonus pelamis*), bluefin tuna (*Thunnus thynnus*), and yellowfin tuna (*Neothunnus macropterus*) were caught in increasing quantities when they appeared off Los Angeles during the summer. Much the same gear as was used in the albacore fishery served in the capture of related species except that large purse seines and boats had to be constructed for taking bluefin tuna.

EXPANSION OF TUNA FISHING GROUNDS

Continuously expanding markets soon encouraged fishermen to extend their operations southward along the coast of Lower California and Central America

FIGURE 2.—Aerial detail of Fish Harbor showing the row of canneries along the north side and accessory industries on the east and west sides. The Japanese village lies behind the canneries and Brighton Beach stretches along Seaside Avenue in the upper right of the picture. (Courtesy Los Angeles Harbor Commission.)

where several of the varieties of tuna were available during autumn, winter, and spring months. San Diego expanded notably as a tuna canning center because of greater nearness to the productive Mexican fishing grounds and it became a strong rival of Los Angeles.

In 1923 Latin-American waters supplied nearly half the tuna landed at San Diego and Los Angeles, and, in 1927 they supplied three times as much as did local waters. At times fishing operations in Mexican territorial waters were curtailed by excessive license fees and export duties imposed upon California fishermen. A fleet of sea-going tuna boats was built after 1927 largely in order to avoid such levies by fishing in waters beyond the limits of Mexican jurisdiction. The large tuna clippers have tended to displace the smaller boats since 1930 and the fishing grounds have been expanded southward to the equator and as far west as Hawaii.

In 1930, the peak year of the tuna fishery, 40 per cent of the California receipts of 111 million pounds were taken by Los Angeles canneries (Table I). The remainder was prepared by canneries at San Diego, no tuna canneries being located north of Los Angeles.

WAR-TIME GROWTH OF SARDINE CANNING

In 1916, when the albacore fishery was undergoing rapid expansion, eleven southern California canneries undertook to prepare sardines on a large scale during the idle winter months. The temporary abandonment during the war of the United States market for sardines by European producers stimulated such a move. The industry also found it advantageous to produce a commodity which enabled it to extend the season of operations for fishermen and boats as well as for the canneries. Sardine canning not only was undertaken by tuna plants at Los Angeles and San Diego, but production expanded rapidly at Monterey, where sardines had been prepared continuously in a small way since

1902. Although albacore boats and lampara nets were utilized in the growing sardine industry, they were gradually replaced by more effective purse seine and ring net boats.

In 1917 European and other foreign markets opened to California sardines and many specialized sardine canneries were constructed at Los Angeles, Monterey, and San Diego. Within two years the number of canneries handling sardines within the state increased to about forty and the quantity of fish utilized rose from less than 16 million pounds in 1916 to 158 million pounds in 1918.

Los Angeles became a major center of the new sardine industry chiefly because it possessed large and well-equipped fish canneries eager to extend their operations to new species, because it had available many fishing boats and many skilled fishermen, and because it possessed favorable harbor and transportation facilities for reaching world markets. Then, too, as had been recognized for many years, Los Angeles was favorably situated with respect to waters attracting large numbers of sardines. Economic factors seem, however, to be as important as biological ones in explaining the marked localization of large scale fishing activities in California.

In 1929, when 652 million pounds of sardines were landed in California, 43 per cent were utilized by Los Angeles canneries. Monterey, which is almost exclusively a sardine canning center and which normally surpasses Los Angeles in that phase of the industry, utilized 50 per cent of the state catch.

RECENT CANNING OF MACKEREL

Although mackerel (*Pneumatophorus japonicus diego*) were among the first fish to be experimented with during the early years of the canning industry at Los Angeles harbor, it was not until 1928 that the product became of large commercial importance (Table I). In that year mackerel rose from tenth place among California's commercial fish to a position second only to sardines and tunas in quantity taken.

The outstanding center of that industry was at Los Angeles largely because mackerel could be canned at times when tuna and sardines were not available. Mackerel are abundant along much of the California coast throughout the year, but they are believed to be more consistently available off Los Angeles than along many other portions of the coast. Furthermore, sardine fishermen were able to utilize their boats and nets in the capture of mackerel with only slight alterations in fishing technique. In 1929 three-fourths of the state's catch

TABLE I

LANDINGS OF FISH IN LOS ANGELES COUNTY, 1918–1932 *

(Thousands of Pounds)

Year	*Tunas*	*Sardines*	*Mackerel*	*Others*	*Total*
1918	16,241	78,078	2,346	14,040	110,705
1919	35,144	54,600	2,038	11,934	103,716
1920	35,667	28,183	2,305	10,321	76,476
1921	15,780	23,261	2,231	9,873	51,145
1922	21,035	46,062	1,681	11,112	79,890
1923	14,700	67,493	2,654	10,762	95,609
1924	22,455	116,955	1,960	12,748	154,118
1925	40,352	174,403	1,803	13,833	230,391
1926	31,331	113,494	2,032	10,954	157,811
1927	40,811	143,547	3,340	12,750	200,448
1928	39,100	164,617	30,384	11,908	246,009
1929	38,643	278,053	44,789	11,920	373,405
1930	44,916	174,746	13,120	12,084	244,866
1931	29,085	95,980	12,888	10,418	148,371
1932	27,530	113,984	11,932	8,993	162,439

* Data from California State Fisheries Laboratory. Landings for 1918–1923 inclusive do not include fish from Latin America.

of 59 million pounds was received at Los Angeles canneries.

MAXIMUM DEVELOPMENT OF INDUSTRY

Thus was created an industry which reached its greatest development in 1929 when California fishermen took 857 million pounds of fishery products, or one-fourth the total catch of the United States including Alaska. While Los Angeles became the principal center of the new California fishery, Monterey, San Diego, and San Francisco also shared in the development. In 1929 the Los Angeles district received 45 per cent of the total state catch; Monterey district, 39 per cent; San Diego and San Francisco districts, 7 per cent each; and the remaining 2 per cent was taken in the northernmost part of the state, principally at Eureka, Fort Bragg, and Requa. The development at San Diego paralleled that at Los Angeles in most respects but that at Monterey and San Francisco has been much more specialized, being devoted primarily to sardine canning at the former and to the taking of market fish at the latter.

The catch of fish for sale in fresh fish markets has averaged about 60 million pounds annually for the past decade in California. That branch of the fishery has shown little inclination to increase in spite of the enormous expansion in the catch of cannery fish and despite a steadily increasing population within the state. Los Angeles contributes from one-quarter to one-third the state's catch of market fish, the principal varieties including barracuda (*Sphyraena argentea*), halibut (*Paralichthys californicus*), various rockfish (*genus Sebastodes*), white sea bass (*Cynoscion nobilis*), and yellowtail (*Seriola dorsalis*).

It is significant that salmon which at one time were the basis of an important fish canning industry in central and

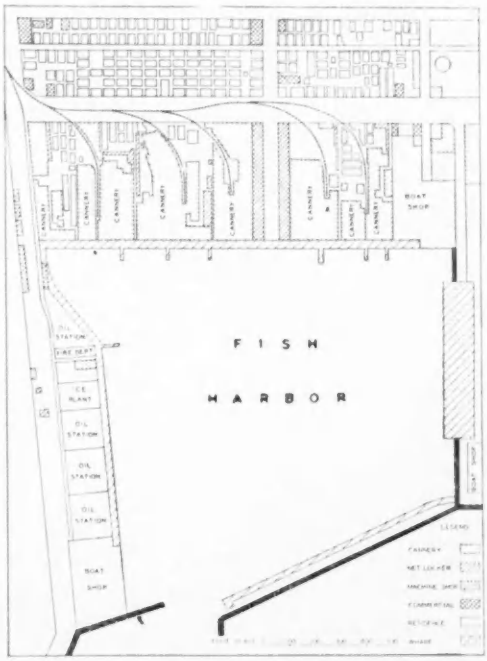


FIGURE 3.—Map of Fish Harbor showing Types of land utilization. Compare with Fig. 2.

northern California now are absorbed entirely by fresh fish markets. Furthermore, the catch of salmon in California continues to decline in an alarming manner, amounting to only 5 million pounds in 1929.

RETRENCHMENT OF INDUSTRY

Like most industrial enterprises in the United States, the California fisheries suffered an important decline following 1929. Loss of established markets and intensified foreign competition were chiefly responsible for the curtailment. The total catch landed in the state amounted to only 441 million pounds in 1932 or half the amount landed at the time of peak development. Deliveries at Los Angeles harbor amounted to 162 million pounds in 1932 or 37 per cent of the state catch (Table I).

FOREIGN TUNA INDUSTRIES

In recent years several small tuna canneries were established in Lower Cali-

fornia (at Cape San Lucas, Turtle Bay, Cedros Island, and Ensenada) in order to share in the exploitation of the rich fishing grounds along that coast. The Mexican industry, however, has never been a serious competitor of the California industry either in the fishing activities or in supplying the markets with the canned product.

FIGURE 4.—View along the main wharf at Fish Harbor. The canneries occur on the left. Tuna purse seine boats line the waterfront. Several purse seines are piled on the wharf. Note the fish elevator towers and flumes connecting with the canneries. (Courtesy California State Fisheries Laboratory.)

Since 1930, however, an important tuna canning industry, patterned after the California fishery, has been established in Japan. The appearance of more than 600,000 cases of Japanese tuna on the United States market during 1933 despite a 30 per cent *ad valorem* duty appears to be a serious threat to the continuance of the local industry. The duty was increased to 45 per cent in December, 1933, for the purpose of protecting the southern California industry, but the levy is not regarded as ample by some producers. Distinctly lower prices paid for fish and for labor gave Japanese canneries an important advantage over California canneries. In 1933 fishermen in Japan received $20 a ton for tuna while those in California received $100 to $110 a ton. Cannery laborers in Japan received 20 to 60 cents a day while in California they received $3 to $6 a day. Shipments of tuna from Japan to New York in new subsidized freighters cost only 22 cents a case or 5 cents more than the cost of delivering California tuna to the same port. Unfavorable exchange rates for the American dollar also were an important factor encouraging imports of foreign tuna in that year.

The ramifications of the tuna industry thus extend far beyond the limits of California. Legal restrictions placed upon fishermen in Latin-American waters and the rise of a competitive industry in the Orient have been reflected by important changes in the conduct and in the success of the local industry. In view of the fact that the California tuna industry is subject to serious foreign competition for the first time, it is likely that a num-

ber of the inefficiencies in obtaining supplies of fish from distant areas and in canning operations will be removed.

RISE OF MODERN FISHING COMMUNITIES IN CALIFORNIA

Among the many interesting results of the growth of the new California fishing industry is the fact that it has created at several ports foreign industrial communities different from other population and factory aggregations in the state. The Japanese fishing village on Terminal Island at Los Angeles Harbor is most striking among such settlements and is the subject for further description and interpretation. A Portuguese settlement at San Diego and Italian colonies at Monterey and San Francisco likewise should afford interesting subjects for geographic analysis. The predominance of foreign-born workers in the California fisheries is one of its most significant characteristics.

FISHERY LAYOUT AT LOS ANGELES

The fish canning industry at Los Angeles is centered principally about a dredged basin, a quarter of a mile square and containing 40 acres of water, in the Outer Harbor on Terminal Island (Figure 1). "Fish Harbor," as the basin is called, was constructed by the City of Los Angeles as a part of the port development program in 1915 and 1916. It should be recalled that at the time of the annexation of San Pedro and Wilmington in 1909 Los Angeles pledged itself to spend $10,000,000 in harbor improvements within a decade. Financial assistance was also secured from the Federal Government, its principal contribution making possible the construction of a rock breakwater 2.11 miles in length which created an extensive and deep Outer Harbor. The initial portion of the government breakwater was completed in 1912.

Terminal Island was formerly a *narrow* sand spit and barrier beach built by ocean currents at the head of San Pedro Bay. Behind it lay a large tract of coastal marsh known as Wilmington Lagoon in which the Inner Harbor has

FIGURE 5.—A group of market and cannery fishing boats along the east side of Fish Harbor. The large boat tied parallel with the wharf is a tuna clipper. Several fish canneries and a boat shop appear in the background.

been developed. After loose rock retaining walls were constructed to outline the new Fish Harbor, dredged materials were deposited about it, thus greatly extending the width of the former spit. A navigation channel dredged through the sand spit near its original easterly connection with the mainland at Long Beach reduced it to an "island." Small ferry boats and two drawbridges give access to the mainland for railroads, highway vehicles, and pedestrians.

As early as 1916, when Fish Harbor was still incomplete, two new fish canneries were established there under 30-year permits, five other permits for cannery sites had been granted, and seven applications for locations were under consideration by the Harbor Commissioners. Several companies had also erected "barracks" for their fishermen on land near the new basin.

Although the seaward front of Terminal Island is exposed to winter storms from the southeast and also to the swell of the open ocean, a 2 1/3-mile extension of the government outer breakwater now

under construction should afford excellent protection to the entrance to Fish Harbor. Smaller breakwaters which form the bounds of Fish Harbor provide smooth water inside that small basin where boats are safe from storms. A 22-foot channel allows the largest fishing

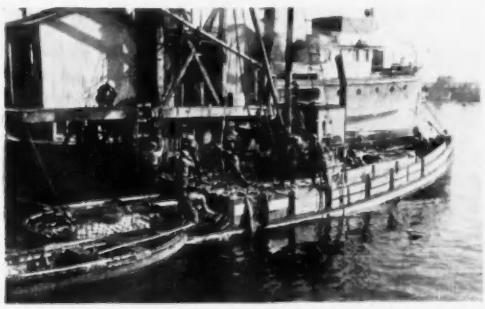


FIGURE 6.—Heavily loaded sardine ring net boat beside a cannery hoist. The net is stowed on deck in the stern of the boat. The sardines are piled on deck about the cabin, side boards being used to hold them in place. A portion of a tuna clipper appears in the background.

boats to enter Fish Harbor and to deliver their catches directly to the canneries. Depths of 12 to 16 feet are afforded in other parts of the basin and are adequate for the anchorage of most fishing boats.

In 1932 a second basin, also containing approximately 40 acres, was completed at the entrance to Fish Harbor. As soon as wharves and slips are provided, anchorage space will be available for several hundred fishing boats, thus making it unnecessary to keep them at various places about the commercial harbor as at present.

The provision of a municipal fish harbor adequate for present and future needs is mainly responsible for the marked localization within the Los Angeles harbor district of fishing operations. Nevertheless, six smaller fish canneries are situated in other portions of the harbor area—three at Long Beach, one on the inner margin of Terminal Island, and two at Wilmington. One by one, however, the scattered canneries are being crowded out by other industries or cease operations, thus furthering the trend toward complete centralization of the industry at Fish Harbor. The occurrence of three canneries at Long Beach is related to the somewhat independent industrial development of that municipality's portion of the harbor.

The wholesale markets, through which pass all the fish products entering the fresh fish trade, are concentrated on a long wharf in San Pedro fronting on the main channel leading into the Inner Commercial Harbor. Small fish markets and fishermen's shacks occupied that site as well as the opposite side of the entrance channel prior to the time of undertaking the extensive improvement of the harbor in 1912. The recent construction of the second anchorage basin at Fish Harbor is likely to promote the complete centralization of fishing operations at Terminal Island as was intended in the original plans for harbor development.

THE FISH CANNERIES

A compact group of eight large fish canneries and associated oil and meal plants flanks Fish Harbor on the northerly side (Figures 2 and 3). Most fish are delivered from boats by conveyor lines and flumes directly to canneries. Larger fish are commonly delivered to the canneries by hand trucks over the 30-foot creosoted-pile wharf extending for 1,500 feet along the north side of the basin (Figure 4). Spur railroad tracks give each cannery warehouse contact with all ocean freight terminals in the harbor district as well as with three transcontinental railroads and an electric railroad serving the entire Los Angeles Basin. One boat repair yard is situated to the east of the canneries along the north side of the basin.

The west side of Fish Harbor is lined

with marine gasoline and diesel oil stations, a large ice-crushing plant for supplying the fishing fleet, and boat building and marine engine repair shops. A harbor fire department boat house is also located on the west side of the basin. That side was originally intended for the wholesale fresh fish markets, but that phase of the industry still remains in San Pedro, as has been explained.

The east side of Fish Harbor affords an extensive operating wharf on which fishermen dry their nets and make repairs. A boat shop and engine works occupy the remainder of the east frontage. Several machine shops are located on barges anchored more or less permanently in Fish Harbor itself.

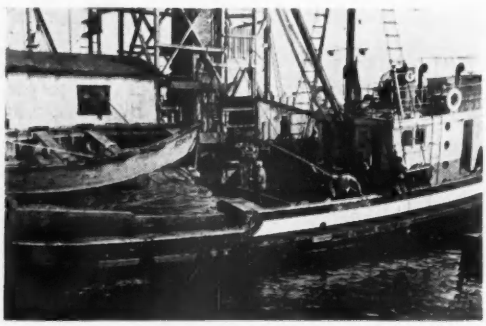


FIGURE 7.—Scooping sardines from the hold of a purse seine boat into the cannery chute. The small boat and purse seine are piled on the heavy turntable which occupies the entire stern.

The fish canneries are one- and two-story structures built of brick or of wood covered with corrugated sheet iron. Mechanical devices are extensively used in the canneries, but there is much opportunity for further systematizing the handling of materials. Although the canning machinery is of the most improved type, much hand work is required in the selection of meat and in the filling of cans. Some 3,000 workers find intermittent employment in the canneries in the harbor district. Japanese, Mexican, and white women perform most of the lighter types of cannery labor. Numerous Filipino, Mexican, and white men are employed in the canneries as laborers and managers. The individual capacities of the larger canneries range from 100 to 400 tons of sardines daily and from 50 to 100 tons of tuna and mackerel. Most of the canneries are equipped to prepare several kinds of fish and thus may operate, with more or less frequent interruptions, throughout the year. Several of the canneries scattered about the commercial harbor have engaged in canning pimentos, olives, and other fruits and vegetables when not handling fish.

A number of fish oil and meal plants usually associated with individual canneries utilize waste products and at times receive surplus catches of sardines for reduction purposes. In 1929 fish by-product plants at Los Angeles harbor produced 20,000 tons of fish meal and 2¼ million gallons of fish oil. Sardines provided the bulk of the fish oil and meal. Soap factories, cooking compound manufacturers, and paint factories afford important local outlets for fish oil products. Intensively cultivated vegetable and fruit farms in southern California utilize fish meal for fertilizer, and poultry and stock farms use it for feeding purposes.

State laws prohibit the diversion of whole sardines under normal conditions to the reduction plants in order to bring about the highest grade use of the resource and to prevent overfishing. As a consequence the growth of the oil and meal industry is definitely restricted by the activities of the canneries and it is prevented from becoming a primary industry even at times when canneries cannot absorb a conservative catch.

Long, narrow buildings divided into lockers (10 x 16 feet) for storing fishing nets constitute another type of structure characteristic of the cannery properties (Figure 3). Large steam-heated

concrete vats in which fishing nets are tanned to protect them from decay also are located in various places about the canneries. Purse seines are treated with tar to preserve them from decay. Company houses which are rented to families employed by the respective canneries commonly fill in all remaining space leased from the harbor commissioners.

The extremely close spacing of structures, their scrambled distribution, and the frequent adjustment of building outlines in conformation with curved railroad spurs and irregular property lines are characteristic features of the building plan of "cannery row." The tall wooden elevators located on short piers along the waterfront and used for raising fish from the boats to flumes connected with the second floors of canneries, are the most striking features of the waterfront itself (Figure 4).

FISHING BOATS

Los Angeles harbor possesses a greater number of fishing boats than any other California port and also a greater variety of boat types. The latter is related to the wide extent of the fishing grounds exploited by Los Angeles fishermen and to the comparatively large variety of fish taken for the canneries and fresh fish markets. It will be recalled that some Los Angeles fishermen go as far south as the equator in search of fares or fish on banks far at sea, while others exploit the margins of kelp beds and large bays within but a few miles of the harbor. In 1929 some 850 different boats delivered catches of fish at Los Angeles, and of them 700 were registered from that port. They varied in size from 15-foot motor boats to converted vessels 167 feet in length.

Most numerous are the small gasoline-driven market fish boats usually 20 to 35 feet in length (Figure 5). Among them are many of the "jig boats" carrying live bait tanks on their sterns and which formerly controlled the local albacore fishery. They also include small lampara net boats formerly engaged in sardine fishing. Hand lines, trolls, set lines, traps, and various types of set and haul nets constitute the gear used by the smaller boats. Most of them operate more or less continuously to supply the local fresh fish demand.

Ring net boats of various types but usually 40 to 55 feet in length also are numerous at Fish Harbor (Figure 6). They have raised forward sections and broad, low sterns on which the large tanned nets are piled. They are responsible for taking most of the cannery mackerel, but they also serve as sardine boats and as market fish boats when opportunity arises. By adding bait tanks they may engage in local tuna fishing operations. All ring net boats are motorized and portions of large catches are piled on the decks since the holds usually are small. Ring nets have larger meshes than purse seines and are hauled by hand.

Purse seine boats are a distinctive type at Los Angeles harbor (Figure 7). They too have raised forward decks and broad, low sterns, but are distinguishable by large turntables on which the nets are carefully piled for casting. A power-roller attached to the turntable aids in hauling the heavy, tarred purse seines. Purse seines are 200 to 350 fathoms in length and 20 to 35 fathoms deep. Such boats are 55 to 80 feet in length and are driven by powerful Diesel engines. They function principally in taking sardines and those species of tuna which are captured in nets. By removing the turntables they may be converted into ring net mackerel boats, and, by replacing the turntables with bait tanks, they may serve as live-bait tuna boats. Some holds are large enough to carry 100 tons or more of fish but occa-

sionally fish are also carried on the decks.

Another distinctive type of fishing boat is the modern high-seas tuna cruiser (Figure 8). They are refrigerated, Dieselized boats, and are constructed exclusively for taking tuna at sea by means of hand lines. The cruisers are 80 to 135 feet in length and have raised forward sections containing the engines and crew quarters. The sterns are low and broad to facilitate the landing of large fish and to accommodate the very large live-bait tanks. The fish are packed in ice beneath the deck in order to preserve them for several weeks or the length of the cruise.

A few larger vessels of various designs have been equipped for high-seas tuna fishing or for transporting tuna from distant fishing grounds to the canneries. Among them are converted submarine chasers, and schooners formerly engaged in the Alaskan salmon fisheries. Their varied designs stand out in sharp contrast, however, to the standard types of fishing boats built to meet the particular requirements of the local industry.

With the expansion of the fishery at Los Angeles, notable changes have taken place in the character of boats. It is a far cry from the Chinese junks and the lateen-rigged feluccas of Mediterranean lands which were common along the California coast in 1880 to the sturdy, engine-driven fishing boats of modern design. The large growth of the southern California fishery during the past two decades was made possible largely through the construction of *larger boats* capable of handling *more efficient gear* and able to travel *long distances* at sea. The various stages in the growth of the local fishery during those years are clearly reflected in the boats of various sizes and designs still to be seen in Fish Harbor.

SEASONAL RHYTHM OF OPERATIONS

Fish Harbor presents an active scene during all the year but the nature of operations and their intensity vary considerably from season to season. The work of overhauling and repairing boats and nets continues throughout the year with periods of greatest activity preceding the opening of each major fishing season. Expansions to new fishing grounds and additions to canneries have in the past at times greatly stimulated boat building operations. Cannery operations fluctuate seasonally in their intensity, but some activity may be seen at most times due to the diversity of products handled and because of the long seasons during which most species are available.

FIGURE 8.—A modern tuna clipper at sea off Lower California. (Courtesy California State Fisheries Laboratory.)

The period November 1 to March 31 constitutes the sardine fishing season in southern California as fixed by state law. Owing to the large tonnages of fish handled and the numbers of boats and persons engaged in the catching and canning of the product, those months are usually the busiest ones of the year. Most sardines are taken at night during the periods of the dark of the moon which tends further to concentrate activities during certain weeks. On dark nights sardines are more easily detected by a phosphorescence caused by tiny marine organisms when disturbed by the schools of fish.

In the early morning boats laden with catches of sardines taken in nearby waters, often just outside the outer breakwater, appear at cannery hoists. Boats from more distant grounds arrive at intervals during the day. With the aid of the motor and boom, the fish are scooped from the boats with long-handled hoop nets, dumped into automatic elevating and weighing devices, and then flumed into the canneries. Flocks of screaming gulls and pelicans (Fish Harbor scavengers) are always present to enliven the scene and to grab any fish which can be reached. Minor repairs to nets are often made while boats await their turns at cannery wharves as well as when they are traveling to and from the fishing grounds.

Mackerel fishing for cannery purposes is engaged in throughout the winter, much like sardine fishing. It is usually carried on by day and during all phases of the moon, thus making for continuous cannery activity during the winter months. Cargoes of refrigerated tuna from Central American and Japanese waters also arrive intermittently throughout the winter season. The latter arrive on ocean liners in frozen form.

The four months (June to September) provide most of the tuna, and since it is the season for local catches many of the smaller live-bait boats are active. Half a hundred of the newer, larger, high-seas cruisers, however, provide the greater share of the tuna since they operate during practically every month in the year. Although they spend a large share of their time at sea, a few of the cruisers may be seen in Fish Harbor at most times while they deliver their catches, undergo repairs, or await orders from canneries to proceed with fishing activities.

Market fishing operations proceed throughout the year with variable success from day to day and with shifts from one species to another as the seasons progress. Stormy weather may cause small fishing boats to remain in port for several days at a time, especially in the winter season. Barracuda, bonito, and yellowtail are taken principally in summer, while the various rockfishes, and mackerel, are taken in greatest quantities in winter. The extension of market fishing operations several hundred miles southward along the coast of Lower California has lengthened the season during which several varieties are available on local markets. Only the larger boats engage in that phase of the market fishery. Since market fish are all handled at a special municipal wharf in San Pedro, Fish Harbor remains at present exclusively a cannery fish center.

When local fishermen are unable to supply market needs, quantities of totuava (*Cynoscion macdonaldi*) are received at the wholesale markets from the head of the Gulf of Lower California. Such shipments are usually made only in winter in part because of the extreme summer heat in the Colorado Delta region and Imperial Valley. Mexican fishermen supply the totuava to the operators of the refrigerated truck lines at the border town, Mexicali.

RESIDENTIAL DISTRICT

Adjoining the canneries on the north, and in places even intermingling with cannery structures, are located some 250 closely spaced, single-story, wooden homes occupied almost exclusively by Japanese fishermen and their families (Figures 2 and 3). The houses were built by cannery interests on land leased from the harbor commissioners. Each group of dwellings associated with a given cannery is called a "camp" by the local residents. The settlement has its own distinctive commercial district as well as its own cultural institutions and

thus it functions more or less as a complete urban unit.

The village, known as "Terminal Island," is one of the largest, most compact, and least Americanized of the Japanese settlements in southern California. It is also exceptional because of its industrial nature, most Japanese settlements in southern California being agricultural or commercial in character.

Most of the village houses are approximately 26 x 45 feet and occupy lots with dimensions of about 30 x 50 feet (Figure 9). The majority of houses contain two three-room apartments separated by a long hallway and thus provide for two families. A few of the smaller houses are occupied by single families and a number are long structures divided into six or eight small apartments housing as many families.

The spaces between the rows of houses are usually only 6 to 10 feet wide and the set-back from the street is even less. Small backyards are often encumbered with small buildings used for toilets and bath houses, which in many instances are attached to the houses. Although the narrow spaces about many houses are cluttered with piles of fuel wood, and discarded boats and fishing gear, diminutive flower and vegetable gardens inclosed by rickety fences often add bits of color to otherwise drab surroundings.

Tiny goldfish ponds with miniature bridges, decorative rocks and shells for borders, and artistically arranged shrubs and flowers occur in several places. Ornamental plants potted in fish kegs and discarded containers of other sorts are seen everywhere and reflect the gardening propensities of the people. All the houses in the village are of the same box-like construction and are painted a dull maroon. Rows of large white Japanese radishes hung on fences to dry and pieces of fish curing on screened frames hung from tall poles above the house tops are other significant traits of the village scene.

FIGURE 9.—View along a narrow and little-traveled residential street in Terminal Island.

The soil on Terminal Island is loose sand which facilitates drainage and makes residential conditions much better than they would be if winter rainfall were not disposed of quickly. Most of the area has been raised slightly above former levels by deposit of materials dredged from harbor channels. An efficient sewage disposal system is installed throughout the village and city water is piped to each house. Natural gas, electricity, and telephones are available throughout the village but not enjoyed in all homes.

Shade trees and lawns are essentially non-existent. Children play on the sidewalks and streets, at the school playground, and along the waterfront. At the east end of the village where much reclaimed land has not yet been occupied by industries some of the villagers maintain poultry yards in an amazing state of disrepair. Discarded fish nets draped over a framework of wood more often serve to enclose the runways than does the usual wire poultry netting.

COMMERCIAL DISTRICT

The village commercial district, extending for nearly a quarter of a mile along the principal north-south street and ending at the waterfront, provides for most of the business requirements of

the fishing population (Figure 10). A bank, a gasoline station and garage; several cafés, drug stores, pool halls, barber shops, liquor stores, hardware stores, food stores and meat markets; a general merchandise store, a novelty shop, a clothing store, a shoe repair shop, a marine engine distributor, an electric shop, and a number of fishing supply stores constitute the mercantile group. A fire station, a post office, a public school, a Buddhist temple, a Baptist mission, a state fishery licensing office and laboratory, a state cannery inspection office, two emergency medical offices, and several clubhouses belonging to various fishermen's commercial organizations complete the list of structures which give character to the village.

Most of the business establishments are operated by Japanese and on every hand the character of merchandise offered indicates the nature of the requirements as well as the tastes of an Oriental fishing populace. Cafés serve meals day and night for "hungry men," fishing tackle and ships' supplies are important items of display throughout the village. Oriental foods and merchandise are offered for sale in all stores, and on every hand advertisements, reading materials and public notices appear in Japanese. Practically all of the conversation heard in the village is Japanese although the children speak English when in school.

On the other hand, many evidences are available to indicate the Americanization of the group. There is no suggestion of the Orient in the architecture of the village except the Buddhist temple, the settlement having been planned and constructed by whites. The dress of men, women, and children is not unlike that to be seen in any fishing village on the Atlantic coast. Automobiles are owned by some of the fishermen, but they are not essential to the industry as is the case with most Japanese gardeners living in the vicinity of Los Angeles. Most of the food served in the cafés and the merchandise offered for sale in stores is identical with that to be found in cafés and stores elsewhere in Southern California. Although the school adjusts its work somewhat to the interests and aptitudes of Oriental children, the character of the work is the same as that done elsewhere in the public schools of California.

The names of streets in Terminal Island are strictly in keeping with the one and only economic interest of the settlement. Tuna Street, Cannery Street, Terminal Way, and Seaside Avenue are the principal thoroughfares. The lesser are Pilchard Street, "Albicore" Street, Sardine Street, Bass Street, Barracuda Street, and Ways Street. The least traveled residential streets and intended parkways frequently serve for net drying and repairing operations as do numerous open tracts of sandy land about the borders of the village.

Another of the interesting characteristics of the "planned" fishing community is the manner in which commercial and industrial interests of entirely different sorts closely border it. Across the street to the west and north, and fronting on the main channel leading into the Inner Harbor, are a large shipbuilding yard, a petroleum shipping terminal, numerous freight sheds and terminals, a lumber receiving and distributing plant, a pipe storage yard, and a railroad classification yard (Figure 2). A little used airport and large tracts of idle industrial land adjoin the village on the east. Such abrupt boundary lines and spatial arrangements point to the deliberate allotment of lands for various uses which preceded the construction of the Fish Harbor project.

Along the main road traversing the length of the Terminal Island sand spit and slightly detached from the Japanese village is a residential area in part occu-

pied by fishermen (Figures 1 and 2). Prior to the important industrial and commercial development of Los Angeles harbor, the narrow sand spit was the site of an attractive summer-residence beach resort. The settlement, named Brighton Beach, stretched for a mile eastward from the point now occupied by the fishing village and it was especially popular among the elite of Los Angeles because of its nearness to the city. With the construction of the modern harbor filling operations pushed the waterfront a considerable distance from "Seaside Avenue" which marked the former margin of the ocean. Furthermore the odors of fish canneries and the noise of planing mills and other industries do not make for an attractive resort area any longer. As a result, the beach homes were abandoned by their former owners and they are now occupied mainly by the families of men employed in various harbor industries. Many of the Slavic and Filipino fishermen as well as a few Japanese find that decadent residential area convenient to their work.

Large numbers of cannery workers and fishermen reside in San Pedro and Wilmington and many commute daily by ferry boats across the 1,000-foot harbor channel. Canneries in Wilmington and Long Beach draw their workers from the residential districts of those cities.

FOREIGN CHARACTER OF CALIFORNIA FISHERMEN

As a conclusion to the analysis of one of the leading fishing settlements of California some explanation should be given for the predominance of foreign-born fishermen at Los Angeles and also in the state (Table II). Only in the small fisheries of the northern coast and the Santa Barbara district does the number of American-born exceed the number of foreign-born. The explanation is largely in terms of principles which account for the selection of workers by most industries everywhere.

In spite of the fact that California fishermen rarely are exposed to such rigorous conditions as maintain in colder and stormier latitudes, the life of the workers is not easy. Much of the work is seasonal and during the fishing periods

FIGURE 10.—A portion of the principal commercial street of Terminal Island looking toward the waterfront.

long and irregular hours must be observed. As has been shown, some types of fishing must be done at night. Since preparations have to be made during the day for the activities of the succeeding night, little time remains for recuperation. Much of the high-seas tuna fishing requires that fishermen be away from their families for weeks at a time. Residential conditions within convenient distance of Fish Harbor are unsatisfactory from the viewpoint of most citizens. Monetary returns are uncertain from season to season as well as from week to week. So much capital is required for the larger boats and their equipment that practically all are owned by the cannery corporations, the crews being merely hired workers. Their pay is based on the amount of the catch. The industry also requires a degree of skill and understanding which usually is possessed only by persons who have had long contact with the sea and with fishing boats and gear. As a consequence the fisheries of California are conducted largely by those nationalities which have had much experience in such activities

and do not hesitate to accept the requirements of the industry and the hardships. Such groups as are willing to have their women engage in cannery operations, thus helping to secure satisfactory family incomes, also are attracted.

In 1932–1933 three-fourths of the 1,842 licensed commercial fishermen in Los Angeles County were born in foreign countries. A considerable number of the remainder were sons of foreign-born fishermen and represented the second generation of fishermen in the local industry. Japanese constituted the largest foreign-born group, accounting for one-third the total number of fishermen. Yugoslavs ranked second with one-fifth, and Italians were third in importance with 7 per cent of the total number of fishermen. Other nationalities having less than 3 per cent of the total number of fishermen included the following in descending order of importance: Norwegian, Russian, Portuguese, Swedish, Danish, Dalmatian, Finnish, Greek, British, Canadian, and German.

Japanese are relatively more important at Los Angeles than at any other fishing port in California. Italians are much more numerous than Japanese in San Francisco and Monterey and Portuguese are slightly more numerous at San Diego than either Japanese or Italians. The Japanese are comparatively new entrants in the California fisheries while Italians and Portuguese are of longer standing.

The majority of Japanese at Los Angeles harbor have been engaged in the tuna industry. It is interesting to note, however, that Portuguese outnumber them in the same industry which developed simultaneously at San Diego. The Japanese developed the most successful method of taking albacore and the large expansion of cannery industries which took place after 1916 at Los Angeles afforded the opportunity for their entry in large numbers into the fishery.

The great number of Yugoslavs at Los Angeles is related to the recent coming of large purse seine boats into the sardine industry from the salmon and herring fisheries of Puget Sound and Alaska. At Monterey Italians are credited with most of the sardine catch, they having been engaged earlier in the market fishery at that place. Most of the Italians at Los Angeles and at San Francisco continue to supply the fresh fish markets. The remaining nationali-

TABLE II

NATIVITY OF CALIFORNIA COMMERCIAL FISHERMEN LICENSED DURING PERIOD OF APRIL 1931–MARCH 1932 BY SELECTED DISTRICTS *

Native Country of Fishermen	*San Francisco Bay*	*Monterey Bay*	*Los Angeles*	*San Diego*	*Entire State*
British Isles	4	3	12	4	27
Canada	1	1	11	3	16
Dalmatia	..	9	22	2	35
Denmark	10	2	22	7	50
Finland	5	..	13	1	57
Germany	19	5	9	5	46
Greece	46	1	12	9	69
Italy	447	404	134	195	1,200
Japan	21	116	603	183	924
Norway	2	3	50	27	104
Portugal	26	9	23	232	297
Russia	3	1	37	2	47
Sweden	15	...	22	25	74
United States	294	230	459	308	1,826
Yugoslavia	15	33	363	5	427
Unclassified	31	43	50	24	412
Total	939	860	1,842	1,032	5,611

* Data from Bureau of Commercial Fisheries, California Division of Fish and Game.

ties are widely distributed throughout the various branches of the fishery which aids in making them inconspicuous.

The fisheries are among the few important industries of California requiring considerable individual skill and the use of expensive equipment in which foreign workers greatly outnumber native whites. The fact that most of the white population of southern California came rather recently from the Central Interior of the United States may help further to account for their avoidance of the maritime pursuit.

THE DEVELOPMENT AND DECLINE OF SKAGWAY, ALASKA

Edwin J. Foscue

SKAGWAY, a small "relic" village of southeastern Alaska, owes its existence and development to the discovery of gold in a region more than five hundred miles away. Its location at the head of the longest fiord in southeastern Alaska, and at the foot of the lowest pass across the coastal range, gave it a greater advantage and prominence during the gold mining days than it enjoys at present.

Skagway is about 1,000 miles from Seattle, the nearest American port. By the White Pass route it is more than 500 miles from the Klondike gold fields around Dawson, in the Canadian Yukon territory (Figure 1).

A small deltaic flat at the mouth of the Skagway River forms a site for the town (Figure 2), between the precipitous walls at the head of the fiord. The delta is built on the floor of a hanging valley which soundings show to be from 200 to 300 feet above the level of the floor of Lynn Canal.[1] In a region where mountain building and excessive glacial erosion have reduced the terrain to a series of precipitous slopes, small bits of level land offer the only sites for settlement, not only in Alaska, but in Norway and other fiorded regions.

Back of Skagway the complex mountain wall of the coastal range raises a

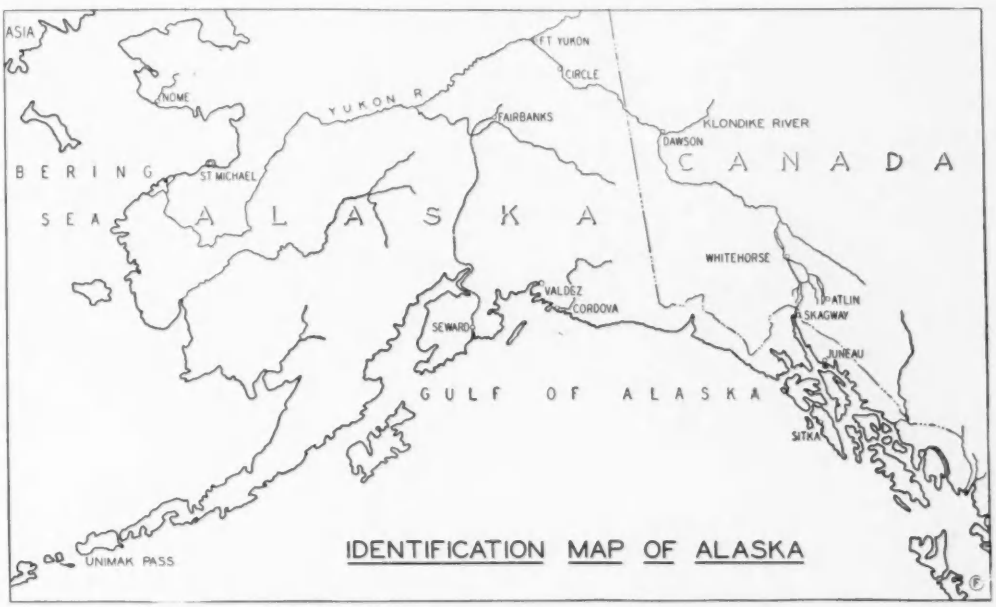


FIGURE 1.—Seward and Nome lie at considerably greater distance from Seattle than does Skagway.

[1] Martin, Lawrence and Williams, Frank E.: "An Ice-Eroded Fiord," *Geographical Review*, Vol. 14, pp. 580–581 (1924).

formidable barrier to communication with the interior. Several routes were in use between the head of the fiord and the Yukon district prior to the gold rush, but all of them involved difficult and dangerous crossings of the coastal range by means of high, snow-filled passes, or a long circuitous route across the barren upland. Two historic passes open near the head of Lynn Canal. Back of the old town of Dyea, the Chilkoot Pass offers the shortest crossing of the barrier, but the grades are steep, and the summit more than 3,500 feet above sea level. White Pass, back of Skagway, was little known during the early days. This route, although longer than that by Chilkoot Pass, has a more gentle grade and a summit level several hundred feet lower. The two passes, the only gaps in the coastal range for more than one hundred miles in either direction, except for the Dalton Trail, naturally directed trade and travel, and for a while developed keen competition, resulting in two rival towns, Dyea and Skagway (Figure 3).

A third pass or route, known as the Dalton Trail, extended into the interior from Haines (sixteen miles south of Skagway) to Fort Selkirk and other points on the Yukon. This route, originally used to drive cattle into the interior, was not suited to the demands of the gold rush because of its length, despite the fact that its summit was even lower than that of White Pass.

FIGURE 2.—Aërial photo of Skagway.

Skagway lies near the inward margin of the West Coast Marine type of climate, but a protected leeward location at the head of the fiord gives the town only a fraction of the normal precipitation for the region (Figure 4). The maximum precipitation falls late in autumn, much of it as snow. Clouds are common throughout the year. Normal monthly temperatures range from 18° in January to 58° in July, but extremes sometimes appear. December, the coldest month, has had an absolute range from −22° to 57°, while July, the warmest month, varies from 36° to 92° (Figure 5). While low winter temperatures

FIGURE 3.—Map of the Skagway area, showing the passes.

are unusual in Skagway, the summit of White Pass experiences freezing temperatures throughout much of the year. Low temperatures, together with the almost impassable terrane of the upland area during the winter season, contributed to the concentration of transient population in the Skagway area during the gold rush.

EARLY DAYS OF THE KLONDIKE GOLD RUSH

Native Indians, traders, and trappers comprised the population of the Skagway region prior to the discovery of gold along the Klondike in 1896. The Chilkoot Indians occupied and dominated the environs of the Chilkoot Pass to such a degree that they were the only packers over the pass when the stampede began. A few trading posts were established along the Chilkoot Pass route as well as along other routes to the south, but no permanent settlements were made in the area. Dyea (or Taiya, the Indian word for *pack* or *load*), established prior to the rush, was of little importance before 1897, while Skagway did not exist at all.

When news reached the outside world that gold had been found along the upper courses of the Yukon River and that fortunes awaited those who would come, a stampede from the United States, Canada, and other parts of the world, started for the Klondike. Seattle, the northernmost Pacific port of the United States, became the logical port of embarkation, and there most of the gold seekers assembled. The two important routes used by the early miners were (1) the all water route from Seattle or San Francisco through the Aleutian Islands to St. Michael, near the mouth of the Yukon, thence by river steamer up the Yukon to Dawson, a total distance of about 4,000 miles; or (2) the water and land route

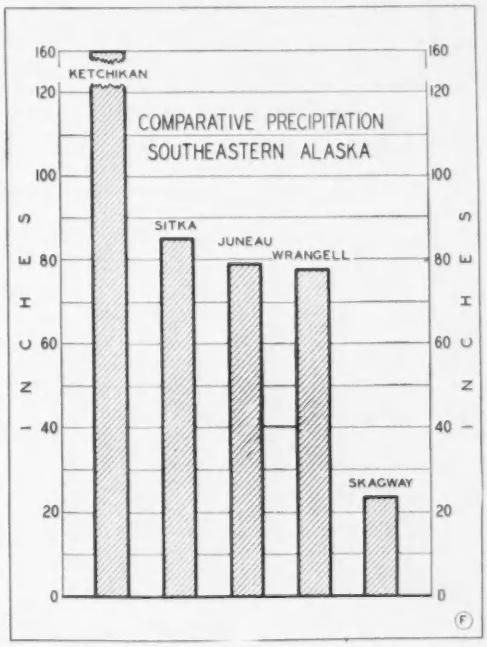


FIGURE 4.—Comparative precipitation in southeastern Alaska.

from Seattle through the inside passage to the head of Lynn Canal, thence by foot from Dyea over the Chilkoot Pass to the headwaters of the Yukon, and from there to Dawson by crudely constructed crafts built by the gold seekers themselves.[2] Of the two, the latter was most used because it offered a shorter trip, despite greater dangers and hardships. During this period the Chilkoot Indians packed most of the merchandise over the pass. The trip over the Chilkoot Pass route was rather hazardous. To begin with, boats were unloaded at Dyea only with difficulty because of extensive shoals in the harbor, and because of the wide tidal range. Goods were either lightered in or discharged onto a rocky point about a mile from shore and transferred to the shore by wagons dur-

[2] Emmons, Samuel Franklin: "Alaska and Its Mineral Resources," *National Geographic Magazine*, Vol. 9, pp. 146–153 (1898).

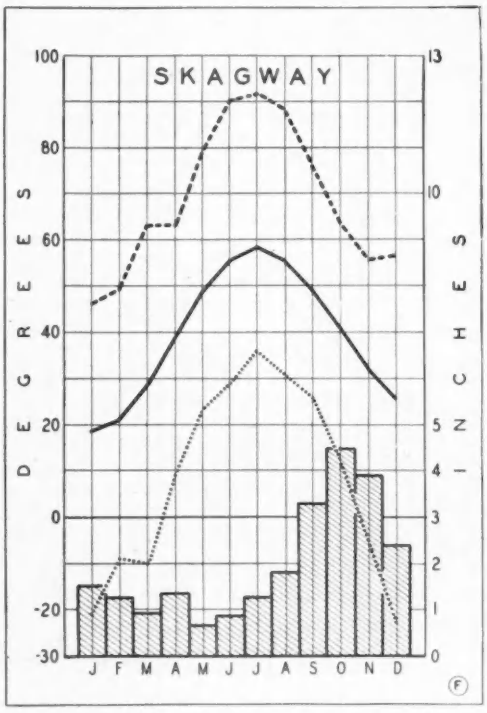


FIGURE 5.—Temperature and precipitation of Skagway.

FIGURE 6.—Chilkoot Pass in 1898.

ing low tide. The first six miles back from the water's edge led up the Dyea River valley by easy grades. The next five miles lay up a rough canyon to Sheep Camp, at the foot of the pass. The next four miles required a climb of about 1,800 feet, but a good trail made foot travel easy. The last half mile of the trip to the summit had a rise of 1,000 feet, making it impassable for pack animals, and extremely difficult for human porters (Figure 6). Beyond the summit of the pass the route led to the head of Lake Lindeman and on to Lake Bennett, where rafts were constructed, from timber growing nearby, for the trip through the rapids and down the Yukon to Dawson. The distance from the head of Lake Bennett to Dawson was about 550 miles.

FIGURE 7.—Skagway harbor.

When the demand for transportation increased with the ever growing number of men who went over the trail, other routes to the headwaters of the Yukon were explored. For some reason, the pass at the head of the Skagway inlet had been overlooked up to that time. A possible explanation of this lies in the fact that Chilkoot Pass was dominated by the Chilkoot Indians, who considered distance a greater hardship than a steep climb with snow hazards, particularly since they were not attempting to carry heavy loads over the mountain range. With a demand for better transportation, White Pass, with a lower grade and a summit several hundred feet below that of Chilkoot, became the main channel for the transit of men and merchandise, and the Chilkoot route was abandoned.

Skagway had better docking facilities for boats than Dyea. Wharves were soon built to enable steamers to unload directly to land conveyances (Figure 7). The trail, later followed by the railroad, led from the town up the valley of the Skagway River, until the summit of White Pass was reached at an altitude of about 2,800 feet. From the summit the route led directly to the head of Lake Bennett, and there joined the Chilkoot route to continue by lake and river to Dawson (Figure 3).

Traffic over the passes reached such volume by 1898 that the construction of a railroad to the Klondike seemed advisable. Several routes from the United States and Canada were surveyed, including one up the Stikine River and through British Columbia to the Yukon, but none proved feasible. Finally White

FIGURE 8.—White Pass in winter.

Pass was selected as the best route over the mountain wall, and likewise the most economical because it offered the shortest land route, and the longest water route to the gold fields. The original survey party arrived in Skagway in the spring of 1898. By the end of that season construction work began. Operations were pushed so rapidly that by July trains were moving over the first four miles of track. By the end of August they ran to White Pass City, a camp for the miners at the foot of the pass, miles from Skagway to the summit of White Pass.

The two most difficult engineering feats on the railroad were at Tunnel Mountain, where the roadbed had to be cut in the face of a solid wall of granite by men suspended on ropes from above, and at Dead Horse Gulch, where a steel cantilever bridge 215 feet high was erected across the chasm (Figure 9). In addition to the difficulties accruing from the topography, great expense and delay were involved in the transport of

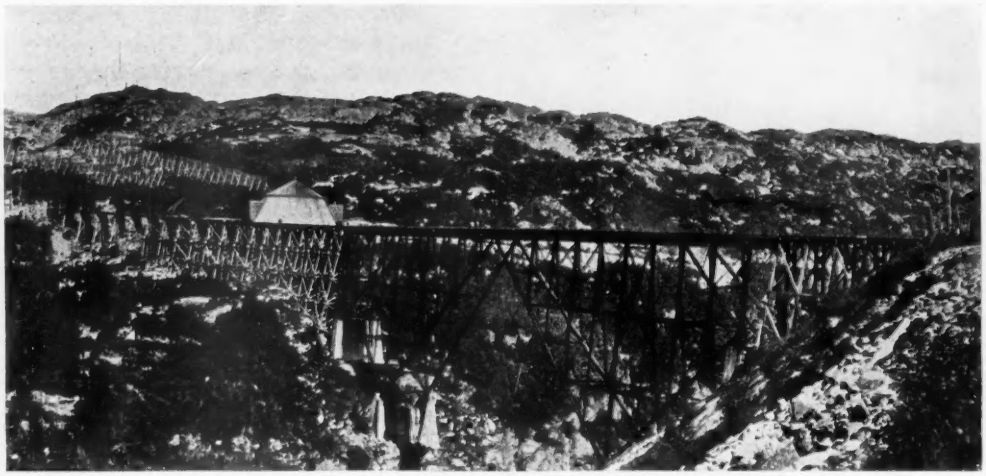


FIGURE 9.—Dead Horse Gulch bridge.

nearly fourteen miles from the harbor. In February, 1899, the railroad reached the summit (Figure 8); and on July 6, 1899, it was completed to the head of Lake Bennett, a distance of 41 miles from Skagway. From the head of Lake Bennett the railroad ran along the east side of the lake to Carcross, and finally to White Horse, 110 miles from Skagway. There connections were made with river steamers during the summer season for the remainder of the trip down the Yukon to Dawson and Fairbanks. Numerous obstacles had to be overcome in this section, but most of the difficulty of construction came within the first twenty

supplies, by the distance from Seattle. Besides this, the successive discoveries of gold impelled men to quit their railroad work, and leave for the diggings. On August 8, 1899, some 1,500 employees quit work on the tracks and started for the gold fields, thereby retarding construction until a new supply of labor could be brought in from the States. The railroad was completed in a little more than two years, during which time about 35,000 men worked on the line. The average cost of construction was about $100,000 per mile from Skagway to the summit, and slightly less for the rest of the route. At present the rail-

road is operated daily during the summer and semi-weekly during the winter season. This data is from the files of the White Pass and Yukon Railroad, and was supplied through the courtesy of Mr. W. C. Blanchard, Assistant to the President, in charge of the Skagway office.

Like many such enterprises, the White Pass and Yukon Railroad was completed a little too late to make use of the peak of shipment across White Pass, and the Klondike rush did not last long enough for the railroad to realize much on its investment. By October, 1900, the decline had started in the Klondike, and the Skagway region had begun to lose its transient population to more prosperous areas.

The building of the railroad across the summit of White Pass revived an old boundary dispute between the United States and Great Britain which was finally settled by placing the boundary at the crest of the pass (Figure 10). Skagway thus became an American town, although it still serves as the chief outlet port for a large Canadian territory in the Yukon and Lake Atlin areas.

BEGINNING OF THE DECLINE

The official census for the year 1900 gave Skagway a population of 3,117, a figure considerably lower than the estimate of 1898. Skagway claimed between 15,000 and 30,000 people during the height of the rush. By 1910 the population had dropped to 872, by 1920 to 494, and by 1930 to 492. Thus Skagway began its decline very shortly after its boom, and by the time of the first census in 1900, was well on the down hill road.

There are four probable causes of this decline. First, the year 1898 marked the discovery of gold in the beach sands at Nome, Alaska. The new find initiated a second stampede as great if not greater than the Klondike rush, but this time traffic went by the all water route from San Francisco or Seattle directly to the new gold fields, and did not use the Skagway-White Pass route. Furthermore, many residents of the Skagway region moved to the new area, and Nome became the next boom town of Alaska. This new region diverted traffic from Skagway as Nome replaced the Klondike as the bonanza gold field thereby reducing the advantages of its strategic location.

The second cause was the completion

FIGURE 10.—Monument marking the international boundary at the summit of White Pass.

of the White Pass and Yukon Railroad, which reduced the demands for laborers in the region. Not only did the completion of the railroad cause men to be discharged from construction jobs, but it also threw out of employment the great army of men and many hundreds of horses used in laboriously moving goods over the pass, since four men in charge of a railroad train could transport quickly and easily in a day the same merchandise that would require weeks for men and animals to move. Most of the unemployed men went on over the trail to the gold fields.

The third cause was the projected construction of various railroads back into

the interior from the head of the Gulf of Alaska. While numerous short lines were completed during the decade 1900 to 1910, including the Copper River and Northwestern Railroad from Cordova on the Gulf to the copper mines at Kennecott, the final completion of the government railroad from Seward on the Gulf to Fairbanks in the Yukon Valley in 1923,[3] awaited the closing of the World War. This railroad building activity tended to divert people from the Skagway area to the country around Cordova and Seward. With the completion of the Alaska Railroad to Fairbanks, a distance of 470 miles, the upper Yukon Valley was successfully tapped by a line operating entirely within American territory, and much of the traffic that formerly ascended the Yukon to make connections with the White Pass and Yukon Railroad now moves out by Seward. The recent agricultural development around Fairbanks has had no influence upon Skagway.

FIGURE 11.—Broadway, the "Main Street" of Skagway.

A probable fourth cause of the decline was the World War. The selective draft, or the high wages offered by shipyards and army cantonments, depleted many isolated areas like Skagway of their ablest and strongest population. After two or three years in the United States or overseas, some of the younger men did not return but found work in the States.

[3] Wilkerson, Albert S.: "Fairbanks, Alaska: A Study of Its People and Their Environment," *Bulletin of the Geographical Society of Philadelphia*, Vol. 31, pp. 145–146. This article (pp. 131–174) gives an excellent description of the Fairbanks region.

SKAGWAY TODAY

Skagway today, like many mining towns of Colorado or elsewhere, is largely a ghost city. Broadway (Figure 11) with its old plank sidewalks and deserted stores, shows little signs of life except when a boat is in the harbor, or when the train comes puffing up the center of the street.

The permanent residents of the town form an interesting group. Composed of railroad officials and employees, shopkeepers, a few professional men, and some prospectors, Skagway today presents every evidence of a well organized, intellectual, and fairly prosperous community. A public library, partly supported by government funds, and a good school system constitute a fair indication of the cultural life of the community.

Yet the town is asleep. The people seem content with what they have, and make few attempts to better conditions or to commercialize the resources of the community. Some seem to be waiting for a second gold rush to start the town on another boom, while the rest seem content with conditions as they are, satisfied to sell a few trinkets or "totem-poles" to the summer tourists. The scenery around Skagway and the history in the immediate vicinity could be "sold" to the tourists if properly advertised. Furthermore, with the long days of summer and abundant moisture, flowers grow in great profusion and luxuriance. Skagway could make itself an Arctic floral display during the months when the tourists visit. At present only two citizens of the town have made any attempt to capitalize on this floral wealth.

As the only port for the Yukon and upper British Columbia territories of Canada, Skagway has freight and passenger traffic over the White Pass and Yukon Railroad sufficient to attract three regular steamers each week. The Canadian National as well as the Canadian Pacific operates from Vancouver, and the Alaska Steamship Company from Seattle. The three lines carry as many as six hundred passengers each week into the Skagway area during the peak of the season, but aside from the sale of curios, the town profits little from the large tourist traffic, because the railroad takes them on into British territory either to Dawson or to Lake Atlin, since Skagway has no hotel or inn to care for many visitors. Thus Skagway misses a golden opportunity. The two or three small hotels in the area, remnants of the pioneer days of '98, with few modern conveniences, are incapable of caring for as many as two hundred tourists. Because accommodations are decidedly inferior to those on the steamships, tourists remain in the town only as long as the boat stays. While Skagway would do well to keep up the appearance of the wild frontier town of 1898 when Soapy Smith and his gang of gamblers ruled the community—and might even rebuild some of the old town to resemble the days of the gold rush—modern hotel accommodations must be provided to attract the tourist to stay in the town for any length of time. Hotel construction would be too expensive for the people of Skagway, and could be financed only as a joint project of the railroad and steamship companies. Some years ago the White Pass and Yukon Railroad acquired a large block of land on the waterfront for the purpose of building a modern tourist hotel, but decreased tourist business, due to the depression, caused them to defer construction. If the three competing steamship lines would coöperate in the building of hotels in the White Pass region, and would rearrange their schedules so that boats would coöperate rather than compete in carrying passengers, tourists could be transported from place to place in southeastern Alaska with a two- or three-day stopover at each company-owned hotel, and all parties concerned might realize an income from the tourist trade. However, such coöperation does not appear likely in the near future. Not only is there commercial competition between companies, but an international rivalry which has always worked to the disadvantage of Skagway. The international boundary at the head of White Pass, which places all of the hinterland under the British flag and the port of Skagway under the American, is in some respects a greater barrier than the coastal range has ever been, even in the pre-railroad days. The Atlin and Klondike regions are without a port in their own country, and Skagway is a port without a country. In many respects the town and port would be more prosperous if a part of Canada.

FIGURE 12.—The town of Skagway from its mountain park.

The Skagway of the future is unpredictable. Present trends indicate that it will decrease in population (Figure 12), but will remain a port of some importance as long as the railroad continues to operate. Its future depends upon the

development of the interior country and upon the tourist trade. The Klondike gold camps are producing greater yields than in years, and the recent increase in the price of gold may stimulate still further production. The commercial development of the port will depend largely upon the development of the mineralized areas of the Upper Yukon. The tourist trade, which has declined during the depression years, may be revived to the 1927–1928 standards, when nearly ten thousand visitors went through the region each summer. Were modern hotels built, and the tourist industry properly developed, Skagway could grow into an important summer resort area. With the exception of the Klondike boom, all advantages that favored the original town are still effective, and no good reason appears why they should not be exploited and utilized.

BOOK REVIEWS

HETTNER, ALFRED. *Vergleichende Landerkunde.* xxiv and 595 pp., numerous maps, charts, and illustrations. B. G. Teubner, Leipzig and Berlin, 1933 and 1934.

In an attractive series of four volumes the veteran master of his field, Alfred Hettner, publishes the ripe results of the many years of research and study of the physical and biological bases of geography. The series comprises the following volumes:

Vol. I. *Die Erde. Land und Meer. Bau und Haptformen des Festlandes.* viii and 221 pp., 106 charts, maps, and illustrations. 1933. Paper R.M. 7.00; Bound R.M. 8.00.

Vol. II. *Die Landoberfläche.* viii and 172 pp., 149 charts, maps, and illustrations. 1933. Paper R.M. 6.40; Bound R.M. 7.40.

Vol. III. *Die Gewässer des Festlandes. Die Klimate der Erde.* viii and 202 pp., 148 maps, charts, and illustrations. 1934. Paper R.M. 7.40; Bound R.M. 8.00.

Vol. IV. *Pflanzen—und Tierwelt. Die Erdraume.* Yet to appear.

It is an exceedingly unfortunate thing that so few of our Americans are able to enter into that rich field of scientific literature that the German language opens up to those who are able to read the language. It is even more unfortunate that since the World War German has not been more generally restored to its place in our school curricula that it held before. Thousands of the youth who will be the scientific leaders of the next generation are receiving no instruction in German, a language which holds a vast store of literature indispensable to a full appreciation of any field of science. And equally unfortunate is it that conditions and political events in Germany at present, tend to delay the return of German to our schools, long after practically all the rancor and resentment of war have been forgotten.

These superb treatises of Hettner's would delight any student of the natural sciences. Not too technical or difficult to be understood and appreciated by the layman, they are still so thoroughly professional and sound as to appeal irresistibly to the trained specialist. They illustrate excellently the loss all our Americans, who cannot read German, must experience in being denied access to the rich subject matter with which they are filled. They are almost essential to every worker in geography and related sciences.

The organization of Volume I indicates how comprehensive each part of series is. Part I of the volume, *Die Erde*, includes *Das Erdganze; Die Naturreiche; Die geographische Ursachlichkeit und das Spiel der Kräfte; Die Geschichte der Erde; Die Erdoberflache der Gegenwart;* and an appendix on *Mathematische Geographie und Kartographie* which embraces chapters on *Die Darstellung der Erdkugel, Die astronomische Ortsbestimmung, Die Kartenaufnahme, Der Kartenmasstab und Messungen auf Karten (Kartometrie), Der Inhalt der Karten,* and *Geographische Bilder.*

Part 2, *Die Feste Erdoberfläche,* comprises two subdivisions: *Land und Meer,* which includes chapters on *Der allgemeine Aufbau der Erdoberfläche, Die Kontinente, Die Bruchzone der Kontinente und die Mittelmeere, Die Gliederung der Kontinente,* and *Die ozeanischen Inseln;* and *Bau und Hauptformen des Festlandes,* which includes chapters on *Die endogenen Vorgänge, Die Typen des inneren Baus, Gesteine und Mineralien, Vulkanische Tätigkeit und Erdbeben,* and *Der Bauplan der Erde.*

It is richly and pertinently illustrated. Every page bears the impress of scholarly research and scrupulous attention to detail. The integrity of point of view as of fact stands out in every statement.

Volumes II and III exhibit the same comprehensiveness, and thoroughness of presentation and similar integrity of research and study. Eight chapters compose Volume II, as follows: 1. *Die Vorggange der oberflachlichen Umbildung;* 2. *Die Formen und Boden der Landoberfläche;* 3. *Tallandschaften und Flussebenen;* 4. *Die tektonischen Typen der Flusslandschaften;* 5. *Die Flusslandschaften in verschiedenen Klimaten;* 6. *Die glaziale Bodengestaltung;* 7. *Die Wusten und Halbwusten;* and 8. *Die Küsten.*

Volume III, which treats of *Das Wasser des Festlandes* and *Die Klimate der Erde,* includes seven chapters on water and eleven chapters on the climatic elements and the climates of the earth, all concisely compacted, yet inclusive and explanatory enough to satisfy the most exacting.

Excellent illustrations enhance the value of all three volumes that have appeared. The paper and binding are good quality, the type clear and legible. The publishers have coöperated with the author to give to geography a series of volumes that grace any bookshelf. When Volume IV comes off the press the series will be complete. Every geographer should be sure to order a set for his own reference library and no library aspiring to a representative collection of good German references can neglect this very excellent series.

W. ELMER EKBLAW

ROORBACH, GEORGE C., with the assistance of FOWLER, WILLIAM A. *Problems in Foreign Trade*. viii and 512 pp., charts and statistical tables. McGraw-Hill Book Company, Inc., New York, 1933. Price, $5.00.

The purpose of the book, as stated in the preface by the late Professor George C. Roorbach, "to develop an understanding of the principles of international trade and their practical applications in the formulation of foreign trade policies and in the development of methods for carrying on of international commercial transactions" by means of the actual experiences of business firms is adhered to admirably. The problems are well chosen. The organization of the material is apt. It is true that the nature of international trade prohibits the inclusion of all types of business enterprises engaged therein, but the author presents a wide range of commodities representing leading industries from many sections of the United States. These commodities are marketed in all the chief trading areas of the world and many facts and principles of importance are derived from a study of them. The author omits material dealing with the technique of importing.

The fact that this approach presents international trade from the point of view of private enterprise rather than that of public welfare is taken into account in Part I, "Trends in American Foreign Trade." This portion of the book provides a broad basis for the understanding of the basic principles of international trade. In the remainder of the book, problems occupy the entire attention of the reader although each group of problems and many of the individual problems are preceded by references to the leading textbooks in the field. It is not the province of the book to discuss the exporting field after the fashion of a textbook principle, but to encourage thought and stimulate reasoning in typical experiences which arise in the field of export trade.

That portion of the book of most interest and value to the geographer is the first 227 pages, or about one-fifth, which includes Part I, "Trends in American Foreign Trade," and Part II, "Factors in Foreign Trade Development." Part II is further divided into sections dealing with the export of raw materials and foodstuffs, the export of manufactures, the marketing of services, foreign investments and foreign trade, government relation to foreign trade, and importing and tariffs. The subjects listed indicate the wide range of problems considered.

The character of the remainder of the book is evident in the titles listed: Part III, "Export Merchandising"; Part IV, "American Branch Factories Abroad"; Part V, "Credit, Financing, and Exchange Problems"; Part VI, "Transportation and Marine-Insurance Problems."

The book presents practical descriptive material of actual business problems in the field of export trade. The wise choice and excellent organization of materials makes this a valuable book for those interested in international trade either as participants or students.

The book is printed on excellent paper, well bound, and the type is clear and easy to read.

ALBERT S. CARLSON

ANNOUNCEMENT

IN THE January issue of ECONOMIC GEOGRAPHY Dr. Robert B. Hall of the University of Michigan will continue the *Agricultural Regions of Asia* concluding his discussion of the Japanese Islands. In subsequent issues Dr. Samuel Van Valkenburg will continue *Agricultural Regions of the World* with additional detailed contributions on *Agricultural Regions of Asia*. In later issues Dr. Homer L. Shantz, President of the University of Arizona, will contribute his series on *Agricultural Regions of Africa* which, upon conclusion, will complete the finest geographic discussion of the world's agriculture thus far established.

To obtain the complete series of these extremely valuable articles, which present for the first time on such a comprehensive and accurate basis the significant divisions of the world's most important industry, it will be necessary to subscribe at once for ECONOMIC GEOGRAPHY, and to order the several back numbers.

In addition to this series of articles on agriculture, other series are being initiated; every issue will also contain four or five articles dealing with urban and regional geography, with problems of land utilization, with programs of development of resources, with commerce, with transportation, with health, and with the hundred and one other subjects that are of present geographic interest, all by the most competent and best-informed authorities in their respective fields. ECONOMIC GEOGRAPHY is indispensable to the intelligent citizen.

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Subscription rates are $5.00 the year in the United States and its Territories; $5.50 the year beyond the borders of the United States, except to charter subscribers.

Only a limited number of the first issues of ECONOMIC GEOGRAPHY are available.

The July issue of Volume 10 contains the following articles:

Scottish Carse Agriculture: The Carse of Gowrie, Henry M. Leppard, University of Chicago, Chicago, Illinois.
The Tobacco Growing Industry of North Carolina, Charles E. Landon, Duke University, Durham, North Carolina.
The Structure of Rhine Traffic, Edna E. Eisen, Steuben Junior High School, Milwaukee, Wisconsin.
Land Economy of Warren County, Kentucky: Part III, J. Sullivan Gibson, Kanawha College, Charleston, West Virginia.
Pineapple Industry in Hawaii, John Wesley Coulter, University of Hawaii, Honolulu, Hawaii.
A Geographical Survey for Iowa, George T. Renner, Iowa Forest Survey, Anita, Iowa.
Pine Woods Region of Southeastern Texas, William T. Chambers, Stephen F. Austin, State Teachers College, Nacogdoches, Texas.

April includes:

Agricultural Regions of Asia: Part VI, China, George B. Cressey, Syracuse University, Syracuse, New York.
The Bay Oil Industry of St. John, Earl Shaw, State Normal School, Worcester, Mass.
Location Factor in the Choice of Free Port Sites, S. Axel Anderson, Columbia University, New York, N. Y.
Apple Industry of the Wenatchee Area, Otis W. Freeman, State Normal School, Cheney, Washington.
Markets and Market Areas of East Anglia, Robert E. Dickinson, University of London, England.
Furniture Industry of the Southern Appalachian Piedmont, Ben F. Lemert, Duke University, Durham, North Carolina.
Land Economy of Warren County, Kentucky: Part II, J. Sullivan Gibson, Kanawha College, Charleston, West Virginia.

January includes:

Softwood Resources of Europe, Thorsten Streyffert, College of Forestry, Djursholm, Sweden.
Agricultural Regions of Asia: Part V—India, Samuel Van Valkenburg, Clark University.
The Great Valley of East Tennessee, H. C. Amick, University of Tennessee, Knoxville.
Citrus Fruit Industry of the Los Angeles Basin, Clifford M. Zierer, University of California, Los Angeles.
Land Economy of Warren County, Kentucky, J. Sullivan Gibson, Clark University.
Agricultural Methods on the Canaries, Sören Jensen, University of Copenhagen, Denmark.

The October issue of Volume 9 contains the following articles:

Cereal Production in Turkey, G. Stratil-Sauer, Geographical Institute of Leipzig, Germany.
The California Fruit Industry, Robert W. Hodgson, University of California, Berkeley.
Natural Conditions for Coffee Culture, Olof Jonasson, University of Stockholm, Sweden.
Mining and Tourist Towns in the Canadian Rockies, Stephen B. Jones, Oregon Normal School, Monmouth, Oregon.
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